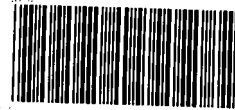


ORIGINAL
(Red)



SDMS DocID

2236123

ORIGINAL
(Red)

A

ORIGINAL
(Red)

EXHIBIT A

CHEMICAL, PHYSICAL & TOXICOLOGICAL
PROPERTIES OF SITE CONTAMINANTS

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
P.O. BOX 1436, SCHENECTADY, NY 12301 USA
(518) 385-2577



NO. 300

ACETONE
Revision C

DATE June 1984

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: ACETONE

OTHER DESIGNATIONS: Dimethyl Ketone, 2-Propanone, CH_3COCH_3 , GE Material D5B24, ASTM D329,
CAS #000 067 641

MANUFACTURER: Available from many suppliers, including:

The Dow Chemical Company
2020 Dow Center

Midland, MI 48640

Emergency telephone: (517) 636-4400

Eastman Chemical Products, Inc.
Kingsport, TN 37662

Tel: (615) 247-0411

SECTION II. INGREDIENTS AND HAZARDS

Acetone

%

HAZARD DATA

ca 100

8-hr TWA 750 ppm
or 1780 mg/m³*

Rat, Oral

LD₅₀ 9.75 g/kg

Rabbit, Skin

LD₅₀ 20 g/kg

Human, Inhalation

TCLo 500 ppm

Eye Irritation &

Eye systemic effects

*ACGIH (1983) TLV; STEL 1000 ppm. Current OSHA PEL
is 1000 ppm. NIOSH (1978) recommended a 10-hr TWA
of 250 ppm or 590 mg/m³ and defined the "action level"
at half this exposure.

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg C ----- ~56

Specific gravity (20/4 C) ----- 0.79

Vapor pressure, mm Hg, at 20 C -- 180

Volatiles, % ----- ca 100

at 25 C -- 226

Melting point, deg C ----- -95

Vapor density (Air=1) ----- 2.0

Evaporation rate (n-BuAc=1) ----- ~7.7

Water solubility ----- Miscible

Molecular weight ----- 58.09

Appearance & Odor: A clear, colorless, volatile liquid with a characteristic, pleasant
sweetish odor. Odor recognition threshold (100% of test panel) 100-150 ppm (also
reported between 200 and 400 ppm); distinct odor at 680 ppm.

SECTION IV. FIRE AND EXPLOSION DATA

Lower

Upper

Flash Point and Method

Autoignition Temp.

Flammability Limits in Air

-4 F (-20C) (TCC)**

>538 C

% by volume**

2.79

13.2

(at 77F)

(at 75F)

Extinguishing media: CO₂, alcohol foam, dry chemical or water spray. Water spray may not
be effective in extinguishing.* Use water to cool fire-exposed containers and to dilute
and reduce fire intensity. Class B fires; use a blanketing effect to smother flame.
Dangerous fire hazard and moderate explosion hazard when exposed to heat and flame.
Firefighters should use self-contained breathing apparatus.

*10% solution of acetone in water is reported to have ~80F flash point.

**Higher closed cup flash points, lower LEL and lower UEL also are reported.

SECTION V. REACTIVITY DATA

Acetone is stable in closed container under normal storage and use conditions. It does
not undergo hazardous polymerization.

This OSHA Class IB flammable liquid reacts vigorously with strong oxidizing agents, such
as nitrates and perchlorates or concentrated sulfuric acid. Incompatible with nitric
and sulfuric acid mixture (can be explosive) and with nitric and acetic acid mixture.

Ignition on reaction with potassium t-butoxide.

Thermal-oxidative degradation can include carbon monoxide.

OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR INORGANIC ARSENIC AND ITS COMPOUNDS (as As) POTENTIAL HUMAN CARCINOGEN

INTRODUCTION

"Inorganic arsenic" is defined as elemental arsenic and all of its inorganic compounds except arsine (see guideline for arsine). This guideline summarizes pertinent information about inorganic arsenic for workers, employers, and occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; therefore, readers are advised to regard these recommendations as general guidelines.

SUBSTANCE IDENTIFICATION

Data in the following section are presented for elemental arsenic.

- **Formula:** As
- **Synonyms:** Arsenic black, arsenic-75, arsenic solid, arsenic metallic, arsenicals, grey arsenic
- **Identifiers:** CAS 7440-38-2; RTECS CG0525000; DOT 1558, label required: "Poison"
- **Appearance and odor:** Gray metal with an odor like garlic when heated

CHEMICAL AND PHYSICAL PROPERTIES

Data in the following section are presented for elemental arsenic.

- **Physical data**
 1. Molecular weight: 74.92
 2. Boiling point (at 760 mmHg): 613°C (1,135°F), sublimes
 3. Specific gravity (water = 1): 5.73
 4. Vapor density (air = 1 at sublimation point of arsenic): 2.6
 5. Melting point: Sublimes at 613°C (1,135°F)
 6. Insoluble in water
- **Reactivity**
 1. Incompatibilities: Oxidizing agents and heat
 2. Hazardous decomposition products: Toxic gases and vapors

or fumes (e.g., arsenic oxide fume) may be released in a fire involving arsenic.

3. Caution: Hydrogen gas can react with inorganic arsenic to form arsine.

- **Flammability**

1. Extinguishant: All firefighting agents, except soda-acid
2. Caution: Arsenic is combustible in powder form or by chemical reaction with powerful oxidizers such as bromates, chlorates, iodates, and peroxides.

- **Warning properties**

Evaluation of warning properties for respirator selection: Warning properties are not considered in recommending respirators for use with carcinogens.

EXPOSURE LIMITS

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for inorganic arsenic (except arsine) is 0.01 milligrams of arsenic per cubic meter of air (mg/m³) as a time-weighted average (TWA) over an 8-hour workshift. The National Institute for Occupational Safety and Health (NIOSH) recommends that arsenic and all its inorganic compounds be controlled and handled as potential human carcinogens in the workplace and that exposure be minimized to the lowest feasible limit. The NIOSH recommended exposure limit (REL) for arsenic and all its inorganic compounds is 0.002 mg/m³ as a ceiling concentration determined in any 15-minute sampling period. The American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV®) for soluble arsenic compounds is 0.2 mg/m³ as a TWA for a normal 8-hour workday and a 40-hour workweek. The ACGIH has designated arsenic trioxide production as A2 (suspected human carcinogen) without having sufficient evidence to assign a TLV® (Table 1).

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Inorganic arsenic compounds may cause adverse health effects following exposure via inhalation, ingestion, or dermal or eye contact.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health
Division of Standards Development and Technology Transfer

and ATS: standardized questionnaires and tests of lung function.

- **Medical practices recommended at the time of job transfer or termination**

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic or laboratory tests which were conducted at the time of placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared to those expected for a suitable reference population. Because occupational exposure to inorganic arsenic and its compounds may cause diseases of prolonged induction-latency, the need for medical surveillance may extend well beyond termination of employment.

- **Sentinel health events**

Delayed-onset SHE's include: Inflammatory and toxic neuropathy, agranulocytosis or neutropenia (absence or a severe decrease in the number of certain white blood cells), and cancers of the liver and respiratory tract.

MONITORING AND MEASUREMENT PROCEDURES

- **Ceiling concentration evaluation**

Measurements to determine worker exposure should be taken during periods of maximum expected airborne concentrations of inorganic arsenic. Each measurement to determine the NIOSH REL (ceiling exposure) in the worker's breathing zone (air that most nearly represents that inhaled by the worker) should consist of a 15-minute sample or a series of consecutive samples that total 15 minutes. A minimum of three measurements should be taken during one workshift, and the highest of all measurements taken is an estimate of the worker's exposure. If the periods of maximum exposure are not clearly defined, a statistical procedure which can be used as a peak exposure detection strategy is given in the *Occupational Exposure Sampling Strategy Manual*.

- **Method**

Sampling and analysis may be performed by collecting particulate inorganic arsenic with cellulose membrane filters followed by digestion with acid and analysis by atomic absorption with flame arsine generation. A detailed sampling and analytical method may be found in the *NIOSH Manual of Analytical Methods* (method number 7900).

PERSONAL PROTECTIVE EQUIPMENT

Chemical protective clothing (CPC) should be selected after utilizing available performance data, consulting with the manufacturer, and then evaluating the clothing under actual use conditions.

Workers should be provided with and required to use CPC, gloves, and other appropriate protective clothing necessary to prevent skin contact with inorganic arsenic.

SANITATION

Clothing which is contaminated with inorganic arsenic should be removed immediately and placed in sealed containers for

storage until it can be discarded or until provision is made for the removal of inorganic arsenic from the clothing. If the clothing is to be laundered or cleaned, the person performing the operation should be informed of inorganic arsenic's hazardous properties. Reusable clothing and equipment should be checked for residual contamination before reuse or storage.

A change room with showers, washing facilities, and lockers that permit separation of street and work clothes should be provided.

Workers should be required to shower following a workshift and prior to putting on street clothes. Clean work clothes should be provided daily.

Skin that becomes contaminated with inorganic arsenic should be promptly washed with soap and water.

The storage, preparation, dispensing, or consumption of food or beverages, the storage or application of cosmetics, the storage or smoking of tobacco or other smoking materials, and the storage or use of products for chewing should be prohibited in work areas.

Workers who handle inorganic arsenic should wash their faces, hands, and forearms thoroughly with soap and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

Common operations in which exposure to inorganic arsenic may occur and control methods which may be effective in each case are listed in Table 2.

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, remove the victim from further exposure, send for medical assistance, and initiate emergency procedures.

- **Eye exposure**

Where there is any possibility of a worker's eyes being exposed to inorganic arsenic, an eyewash fountain should be provided within the immediate work area for emergency use.

If inorganic arsenic gets into the eyes, flush them immediately with large amounts of water for 15 minutes, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

- **Skin exposure**

Where there is any possibility of a worker's body being exposed to inorganic arsenic, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

If inorganic arsenic gets on the skin, wash it immediately with soap and water. If inorganic arsenic penetrates the clothing, remove the clothing promptly and wash the skin with soap and water. Get medical attention promptly.

- *Code of Federal Regulations*, U.S. Department of Labor, Occupational Safety and Health Administration, 29 CFR 1910.1018, OSHA 2206, revised July 1, 1986.
- *Code of Federal Regulations*, U.S. Department of Transportation, 49 CFR 172.101, Transportation 49, revised October 1, 1982.
- Dean, J.A. (ed.): *Lange's Handbook of Chemistry* (12th ed.), McGraw-Hill, Inc., New York, 1979.
- Goldman, R.H., and Peters, J.M.: "The Occupational and Environmental Health History," *Journal of the American Medical Association*, 246:2831-2836, 1981.
- Halperin, W.E., Ratcliffe, J., Frazier, T.M., Wilson, L., Becker, S.P., and Shulte, P.A.: "Medical Screening in the Workplace: Proposed Principles," *Journal of Occupational Medicine*, 28(8):547-552, 1986.
- Hankinson, J.L.: "Pulmonary Function Testing in the Screening of Workers: Guidelines for Instrumentation, Performance, and Interpretation," *Journal of Occupational Medicine*, 28(10):1081-1092, 1986.
- Hawley, G.G.: *The Condensed Chemical Dictionary* (10th ed.), Litton Educational Publishing, Inc., New York, 1981.
- International Agency for Research on Cancer: *IARC Monographs on the Carcinogenic Risk of Chemicals to Humans, Some Metals and Metallic Compounds*, Vol. 23, Lyon, France, 1980.
- International Agency for Research on Cancer: *IARC Monograph on the Carcinogenic Risk of Chemicals to Humans*, Suppl. 4, Lyon, France, 1982.
- Leidel, N.A., Busch, K.A., and Lynch, J.R.: *Occupational Exposure Sampling Strategy Manual*, U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 77-173, Cincinnati, 1977.
- Levy, B.S., and Wegman, D.H. (eds.): *Occupational Health: Recognizing and Preventing Work-Related Disease*, Little, Brown and Company, Boston, 1983.
- Mark, H.F., Othmer, D.F., Overberger, C.G., Seaborg, G.T., Grayson, M., and Eckroth, D. (eds.): *Kirk-Othmer Encyclopedia of Chemical Technology* (3rd ed.), John Wiley & Sons, Inc., New York, 1978.
- National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control: *NIOSH Manual of Analytical Methods* (3rd ed., Vol. 1), Eller, P.M. (ed.), DHHS (NIOSH) Publication No. 84-100, Cincinnati, 1984.
- National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control: *Registry of Toxic Effects of Chemical Substances* (Microfiche Edition), Sweet, D.V., and Lewis, R.J. (ed.), Cincinnati, April 1985.
- National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control: *Criteria for a Recommended Standard... Occupational Exposure to Inorganic Arsenic: New Criteria—1975*, DHEW (NIOSH) Publication No. 75-149, Cincinnati, 1975.
- National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control: *Occupational Diseases—A Guide to Their Recognition* (rev. ed., 2nd printing) DHEW (NIOSH) Publication No. 77-181, 1978.
- Parmeggiani, L. (ed.): *Encyclopedia of Occupational Health and Safety* (3rd ed.), International Labour Office, Geneva, Switzerland, 1983.
- Proctor, N.H., and Hughes, J.P.: *Chemical Hazards of the Workplace*, J.B. Lippincott Company, Philadelphia, 1978.
- Rom, W.N. (ed.): *Environmental and Occupational Medicine*, Little, Brown and Company, Boston, 1983.
- Rothstein, M.A.: *Medical Screening of Workers*, Bureau of National Affairs, Washington, DC, 1984.
- Rutstein, D.D., Mullan, R.J., Frazier, T., Halperin, W., Melius, J.M., and Sestito, J.P.: "Sentinel Health Events (Occupational): A Basis for Physician Recognition and Public Health Surveillance," *American Journal of Public Health*, 73:1054-1062, 1983.
- Scientific Assembly on Environmental and Occupational Health: "Evaluation of Impairment/Disability Secondary to Respiratory Disease," *American Review of Respiratory Diseases*, 126:945-951, 1982.
- Scientific Assembly on Environmental and Occupational Health: "Surveillance for Respiratory Hazards in the Occupational Setting," *American Review of Respiratory Diseases*, 126:952-956, 1982.
- Weast, R.C. (ed.): *CRC Handbook of Chemistry and Physics* (64th ed.), CRC Press, Inc., Boca Raton, Florida, 1983.

OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR ASBESTOS POTENTIAL HUMAN CARCINOGEN

INTRODUCTION

This guideline summarizes pertinent information about asbestos for workers, employers, and occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; therefore, readers are advised to regard these recommendations as general guidelines.

SUBSTANCE IDENTIFICATION

Data in the following section are presented for various forms of asbestos: (1) Asbestos (mixed forms);

- (2) Chrysotile;
- (3) Amosite;
- (4) Crocidolite;
- (5) Tremolite;
- (6) Anthophyllite;
- (7) Actinolite.

If unspecified, data apply to all forms.

- **Composition:** (1) Not Available;
- (2) $3\text{MgO} \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$;
- (3) $(\text{FeMg})\text{SiO}_3$;
- (4) $\text{NaFe}(\text{SiO}_3)_2 \cdot \text{FeSiO}_3 \cdot \text{H}_2\text{O}$;
- (5) $\text{Ca}_2\text{Mg}_3\text{Si}_8\text{O}_{22}(\text{OH})_2$;
- (6) $(\text{MgFe})_7\text{Si}_8\text{O}_{22}(\text{OH})_2$;
- (7) $\text{CaO} \cdot 3(\text{MgFe})\text{O} \cdot 4\text{SiO}_2$;
- **Synonyms:** (1) Asbestos fiber, serpentine, amphibole;
- (2) Canadian chrysotile, white asbestos, serpentine;
- (3) Brown asbestos, fibrous grunerite;
- (4) Blue asbestos;
- (5) Fibrous tremolite;
- (6) Azbolen asbestos;
- (7) Not available
- **Identifiers:** (1) CAS 1332-21-4; RTECS CI6475000; DOT 2212 (blue) 2590 (white);
- (2) CAS 12001-29-5; RTECS CI6478500; DOT 2590;
- (3) CAS 12172-73-5; RTECS CI6477000; DOT Not assigned;
- (4) CAS 12001-28-4; RTECS CI6479000; DOT 2212;

- (5) CAS 14567-73-8; RTECS CI6560000; DOT Not assigned;
- (6) CAS 17068-78-9; RTECS CI6478000; DOT Not assigned;
- (7) CAS 13768-00-8; RTECS CI6476000; DOT Not assigned

• **Appearance and odor:** A fiber or filament, asbestos may have a "fluffy" appearance. Colors may vary from white, gray, blue, brown, green or yellow. Positive identification requires microscopic examination.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

- 1. Molecular weight: (2) 277.13; (5) 185.03
- 2. Specific gravity (water = 1): 2.5-3.0
- 3. Noncombustible solid

• Warning properties

Evaluation of warning properties for respirator selection: Warning properties are not considered in recommending respirators for use with carcinogens.

EXPOSURE LIMITS

Only asbestos fibers greater than 5 micrometers (μm) in length are considered for the following exposure limits. The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for asbestos is 0.2 fiber per cubic centimeter (cc) of air as a time-weighted average (TWA) concentration over an 8-hour workshift with an action level of 0.1 fiber/cc as an hour TWA. The National Institute for Occupational Safety and Health (NIOSH) recommends that asbestos be controlled and handled as a potential human carcinogen in the workplace and that exposure be minimized to the lowest feasible limit. The NIOSH recommended exposure limit (REL) is 0.1 fiber/cc (in 40-liter air sample) as a TWA concentration for up to an 8-hour workshift, 40-hour workweek. The American Conference of Governmental Industrial Hygienists (ACGIH) has designated asbestos as an A1 substance (suspected human carcinogen, with an assigned threshold limit value/ TLV[®]) of 2 fibers/cc for chrysotile, 0.5 fiber/cc for amosite, 0.2 fiber/cc for crocidolite, and 2 fibers/cc for other forms, as a TWA for a normal 8-hour workday and a 40-hour workweek (Table 1).

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health
Division of Standards Development and Technology Transfer

occupational exposure to asbestos may cause diseases of prolonged induction-latency, the need for medical surveillance may extend well beyond termination of employment.

- **Sentinel health events**

Delayed-onset SHE's include: Scarring of the lungs (asbestosis) and its lining (pleural fibrosis) and cancer of the lungs (bronchogenic lung cancer) and its lining (mesothelioma).

MONITORING AND MEASUREMENT PROCEDURES

- **TWA exposure evaluation**

Measurements to determine worker exposure to asbestos should be taken so that the TWA exposure is based on a single entire workshift sample or an appropriate number of consecutive samples collected during the entire workshift. Under certain conditions, it may be appropriate to collect several short-term interval samples (up to 30 minutes each) to determine the average exposure level. Air samples should be taken in the worker's breathing zone (air that most nearly represents that inhaled by the worker).

- **Method**

Sampling and analysis for airborne asbestos may be performed by collecting asbestos fibers with membrane filters and analyzing by phase contrast microscopy. A detailed sampling and analytical method for asbestos may be found in the *NIOSH Manual of Analytical Methods* (method number 7400).

PERSONAL PROTECTIVE EQUIPMENT

Chemical protective clothing (CPC) should be selected after utilizing available performance data, consulting with the manufacturer, and then evaluating the clothing under actual use conditions.

Workers should be provided with and required to use CPC, gloves, and other appropriate protective clothing necessary to prevent skin contact with asbestos.

SANITATION

Clothing which is contaminated with asbestos should be removed at the end of the work period and placed in nonreusable, impermeable containers for storage, transport, and disposal until it can be discarded or until provision is made for the removal of asbestos from the clothing. These containers should be marked "Asbestos-Contaminated Clothing" in easy-to-read letters. If the clothing is to be laundered or cleaned, the person performing the operation should be informed of asbestos's hazardous properties. Reusable clothing and equipment should be checked for residual contamination before reuse or storage.

A change room with showers, washing facilities, and lockers that permit separation of street and work clothes should be provided.

Workers should be required to shower following a workshift and prior to putting on street clothes. Clean work clothes should be provided daily.

Skin that becomes contaminated with asbestos should be promptly washed with soap and water.

The storage, preparation, dispensing, or consumption of food or beverages, the storage or application of cosmetics, the storage or smoking of tobacco or other smoking materials, or the storage or use of products for chewing should be prohibited in work areas.

Workers who handle asbestos should wash their faces, hands, and forearms thoroughly with soap and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

Common operations in which exposure to asbestos may occur and control methods which may be effective in each case are listed in Table 2.

Table 2.—Operations and methods of control for asbestos

Operations	Controls
During asbestos removal	Process enclosure, wet process (when possible), personal protective equipment
During the production of asbestos or the manufacture of products containing asbestos	Process enclosure, local exhaust ventilation, wet process (when possible), personal protective equipment
During the demolition of buildings	Water spray, personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, remove the victim from further exposure, send for medical assistance, and initiate emergency procedures.

- **Eye exposure**

Where there is any possibility of a worker's eyes being exposed to asbestos, an eye wash fountain should be provided within the immediate work area for emergency use.

If asbestos gets into the eyes, flush them immediately with large amounts of water for 15 minutes, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this substance.

- **Skin exposure**

If asbestos gets on the skin, wash it immediately with soap and water.

- **Rescue**

If a worker has been incapacitated, move the affected worker from the hazardous exposure. Put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILLS AND LEAKS

Workers not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

Diseases—A Guide to their Recognition (rev. ed. 2nd printing), DHEW (NIOSH) Publication No. 77-181, 1978.

- National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control: *Revised Recommended Asbestos Standard*, DHEW (NIOSH) Publication No. 77-169, 1976.
- National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control: *NIOSH Manual of Analytical Methods* (3rd ed., Vol. 1), Eller, P.M. (ed.), DHHS (NIOSH) Publication No. 84-100, Cincinnati, 1984.
- National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control: *NIOSH Testimony to DOL, Statement of the National Institute for Occupational Safety and Health, The Public Hearing on Occupational Exposure to Asbestos*, Public Docket No. H-033C, June 21, 1984.
- National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control: *Registry of Toxic Effects of Chemical Substances* (Microfiche Edition), Sweet, D.V., and Lewis, R.J. (eds.), Cincinnati, April 1985.
- National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control: *Workplace Exposure to Asbestos, Review and Recommendations*, NIOSH-OSHA As-

bestos Work Group, DHHS (NIOSH) Publication No. 81-103, 1980. ORIGINAL
(Red)

- Proctor, N.H., and Hughes, J.P.: *Chemical Hazards of the Workplace*, J.B. Lippincott Company, Philadelphia, 1978.
- Rom, W.N. (ed.): *Environmental and Occupational Medicine*, Little, Brown and Company, Boston, 1983.
- Rothstein, M.A.: *Medical Screening of Workers*, Bureau of National Affairs, Washington, DC, 1984.
- Rutstein, D.D., Mullan, R.J., Frazier, T.M., Halperin, W.E., Melius, J.M., and Sestito, J.P.: "Sentinel Health Events (Occupational): A Basis for Physician Recognition and Public Health Surveillance," *American Journal of Public Health*, 73:1054-1062, 1983.
- Scientific Assembly on Environmental and Occupational Health: "Evaluation of Impairment/Disability Secondary to Respiratory Disease," *American Review of Respiratory Diseases*, 126: 945-951, 1982.
- Scientific Assembly on Environmental and Occupational Health: "Proposed Guidelines for Case Evaluation (of Asbestos-Associated Diseases) Based on Assessment of Evidence Available March 1983," *American Thoracic Society News*, Fall 1983.
- Scientific Assembly on Environmental and Occupational Health: "Surveillance for Respiratory Hazards in the Occupational Setting," *American Review of Respiratory Diseases*, 126:952-956, 1982.

Table 3.—Respiratory protection for asbestos

Condition	Minimum respiratory protection*
Any detectable concentration	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode
Planned or emergency entry into environments containing unknown or any detectable concentration	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode
Firefighting	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode
Escape only	Any air-purifying full facepiece respirator with a high-efficiency particulate filter Any appropriate escape-type self-contained breathing apparatus

* Only NIOSH/MSHA-approved equipment should be used.

Occupational Health Guideline for Soluble Barium Compounds (as Barium)

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

APPLICABILITY

The general guidelines contained in this document apply to all soluble barium compounds. Physical and chemical properties of several specific compounds are provided for illustrative purposes.

SUBSTANCE IDENTIFICATION

Barium nitrate

- Formula: $\text{Ba}(\text{NO}_3)_2$
- Synonyms: None
- Appearance and odor: Odorless white solid.

Barium oxide

- Formula: BaO
- Synonyms: None
- Appearance and odor: Odorless white solid.

Barium carbonate

- Formula: BaCO_3
- Synonyms: None
- Appearance and odor: Odorless white solid.

Barium chloride

- Formula: BaCl_2
- Synonyms: None
- Appearance and odor: Odorless white solid.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for soluble barium compounds is 0.5 milligram of soluble barium compounds per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

• Routes of exposure

Soluble barium compounds can affect the body if they are inhaled or if they come in contact with the eyes or skin. They can also affect the body if they are swallowed.

• Effects of overexposure

1. *Short-term Exposure:* Soluble barium compounds may cause local irritation of the eyes, nose, throat, bronchial tubes, and skin. Soluble barium compounds may also cause severe stomach pains, slow pulse rate, irregular heart beat, ringing of the ears, dizziness, convulsions, and muscle spasms. Death may occur.

2. *Long-term Exposure:* None known

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to soluble barium compounds.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to soluble barium compounds at potentially hazardous levels:

1. *Initial Medical Examination:*

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the heart, lungs, and nervous system should be stressed. The skin should be examined for evidence of chronic disorders.

—14" x 17" chest roentgenogram: Soluble barium compounds cause human lung damage. Surveillance of the lungs is indicated.

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

in neutral 0.08 to 0.1 M solution on rabbit eyes by injection into the cornea or by dropping for 10 minutes on the eye after the corneal epithelium was removed to facilitate penetration." Grant states that "both the oxide and hydroxide are capable of causing severe alkali burns of the eye, similar to those produced by calcium hydroxide."

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

Sampling and analyses may be performed by collection on a cellulose membrane filter followed by leaching in hot water, solution of sample in acid, and analysis in an atomic absorption spectrophotometer. An analytical method for soluble barium compounds is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing

necessary to prevent repeated or prolonged skin contact with barium carbonate, barium chloride, barium nitrate, or liquids containing these compounds.

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent skin contact with barium oxide or liquids containing barium oxide, where skin contact may occur.

• If employees' clothing has had any possibility of being contaminated with barium carbonate, barium chloride, barium nitrate, barium oxide, or liquids containing these compounds, employees should change into uncontaminated clothing before leaving the work premises.

• Clothing contaminated with barium carbonate, barium chloride, barium nitrate, or barium oxide should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of contaminant from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the contaminant, the person performing the operation should be informed of contaminant's hazardous properties.

• Where exposure of an employee's body to barium oxide or liquids containing barium oxide may occur, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

• Non-impervious clothing which becomes contaminated with barium carbonate, barium chloride, barium nitrate, or barium oxide should be removed promptly and not reworn until the contaminant is removed from the clothing.

• Employees should be provided with and required to use dust- and splash-proof safety goggles where there is any possibility of barium oxide or liquids containing barium oxide contacting the eyes.

• Employees should be provided with and required to use dust- and splash-proof safety goggles where barium carbonate, barium chloride, barium nitrate, or liquids containing these compounds may contact the eyes.

• Where there is any possibility that employees' eyes may be exposed to barium oxide or liquids containing barium oxide, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

• Workers subject to skin contact with barium oxide or liquids containing barium oxide should wash any areas of the body which may have contacted barium oxide at the end of each work day.

• Skin that becomes contaminated with barium carbonate, barium chloride, or barium nitrate should be promptly washed or showered to remove any contaminant. In the case of barium carbonate, employees should use soap or mild detergent and water for washing purposes.

ORIGINAL
(Red)

• Skin Exposure

If solutions of barium compounds get on the skin, immediately flush the contaminated skin with water. If solutions of barium compounds soak through the clothing, remove the clothing immediately and flush the skin with water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of soluble barium compounds, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When soluble barium compounds have been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.

• If soluble barium compounds are spilled, the following steps should be taken:

1. Ventilate area of spill.
2. Collect spilled material in the most convenient and safe manner and deposit in sealed containers for reclamation or for disposal in a secured sanitary landfill. Liquids containing soluble barium compounds should be absorbed in vermiculite, dry sand, earth, or a similar material.

• Waste disposal method:

Soluble barium compounds may be disposed of in sealed containers in a secured sanitary landfill.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Barium and Compounds (as Ba)," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- American Industrial Hygiene Association: "Barium and Its Inorganic Compounds," *Hygienic Guide Series*, Detroit, Michigan, 1962.
- Baskin, A. D. (ed.): *Handling Guide for Potentially Hazardous Commodities*, Railway Systems and Management Association, Chicago, 1972.
- Browning, E.: *Toxicity of Industrial Metals* (2nd ed.), Butterworths, London, 1969.
- Christensen, H. E., and Luginbyhl, T. L. (eds.): *NIOSH Toxic Substances List*, 1974 Edition, HEW Publication No. 74-134, 1974.
- Deichmann, W. B., and Gerarde, H. W.: *Toxicology of Drugs and Chemicals*, Academic Press, New York, 1969.
- Gleason, M. N., Gosselin, R. E., Hodge, H. C., and Smith, R. P.: *Clinical Toxicology of Commercial Products* (3rd ed.), Williams and Wilkins, Baltimore, 1969.
- Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.
- International Labour Office: *Encyclopedia of Occupational Health and Safety*, McGraw-Hill, New York, 1971.
- Jacobs, M.: *The Analytical Chemistry of Industrial Poisons, Hazards, and Solvents*, Interscience, New York, 1956.
- Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.
- Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.
- Spector, W. S. (Vols. I, II), Negherbon, W. O. (Vol. III), Grebe, R. M. (Vol. IV), and Dittmer, D. S. (Vol. V) (eds.): *Handbook of Toxicology*, Saunders, Philadelphia, 1956-1959.
- Thienes, C. H., and Haley, T. J.: *Clinical Toxicology* (5th ed.), Lea and Febiger, Philadelphia, 1972.

BUTYL BENZYL PHTHALATE

BPH

(ORIGINAL
(Red))

Common Synonyms Benzyl n-butyl phthalate Phthalic acid, benzyl butyl ester		Liquid Sinks in water.	Colorless Slight odor
Stop discharge if possible. Avoid contact with liquid. Isolate and remove discharged material. Notify local health and pollution control agencies.			
Fire		Combustible. Irritating gases may be produced when heated. Extinguish with dry chemicals, alcohol foam, or carbon dioxide. Water may be ineffective on fire. Cool exposed containers with water.	
Exposure		CALL FOR MEDICAL AID. LIQUID Irritating to skin and eyes. Remove contaminated clothing and shoes. Flush affected areas with plenty of water.	
Water Pollution		Effect of low concentrations on aquatic life is unknown. May be dangerous if it enters water intakes. Notify local health and wildlife officials. Notify operators of nearby water intakes.	
1. RESPONSE TO DISCHARGE (See Response Methods Handbook) Should be removed Chemical and physical treatment		2. LABEL 2.1 Category: None 2.2 Class: Not pertinent	
3. CHEMICAL DESIGNATIONS 3.1 CG Compatibility Class: Ester 3.2 Formula: $C_{12}H_{16}O_4$ 3.3 MSD/UN Designations: Not listed 3.4 DOT ID No.: Data not available 3.5 CAS Registry No.: 85-68-7		4. OBSERVABLE CHARACTERISTICS 4.1 Physical State (as shipped): Liquid 4.2 Color: Colorless 4.3 Odor: Slight characteristic	
5. HEALTH HAZARDS 5.1 Personal Protective Equipment: Protective gloves and goggles 5.2 Symptoms Following Exposure: Prolonged contact with liquid causes some irritation of eyes and skin. 5.3 Treatment of Exposure: EYES: Flush with water for 15 min. SKIN: wash well with soap and water. 5.4 Threshold Limit Values: Data not available 5.5 Short Term Inhalation Limits: Data not available 5.6 Toxicity by Ingestion: Grade 1; oral rat LD ₅₀ = 13,500 mg/kg 5.7 Late Toxicity: Data not available 5.8 Vapor (Gas) Irritant Characteristics: Vapors are nonirritating to eyes and throat. 5.9 Liquid or Solid Irritant Characteristics: No appreciable hazard; practically harmless to skin. 5.10 Odor Threshold: Data not available 5.11 IDLH Values: Data not available			

6. FIRE HAZARDS 6.1 Flash Point: 300°F O.C. 6.2 Flammable Limits in Air: Data not available 6.3 Fire Extinguishing Agents: Dry chemical, carbon dioxide, foam 6.4 Fire Extinguishing Agents Not to be Used: Water or foam may cause frothing. 6.5 Special Hazards of Combustion: Products: irritating vapors of unburned chemical may form in fires. 6.6 Behavior in Fire: Data not available 6.7 Ignition Temperature: Data not available 6.8 Electrical Hazards: Data not available 6.9 Burning Rate: Data not available 6.10 Adiabatic Flame Temperature: Data not available 6.11 Stoichiometric Air to Fuel Ratio: Data not available 6.12 Flame Temperature: Data not available		10. HAZARD ASSESSMENT CODE (See Hazard Assessment Handbook) A-X																																					
7. CHEMICAL REACTIVITY 7.1 Reactivity With Water: No reaction 7.2 Reactivity with Common Materials: Data not available 7.3 Stability During Transport: Stable 7.4 Neutralizing Agents for Acids and Caustics: Not pertinent 7.5 Polymerizations: Not pertinent 7.6 Inhibitor of Polymerization: Not pertinent 7.7 Water Ratio (Resistant to Product): Data not available 7.8 Reactivity Group: Data not available		11. HAZARD CLASSIFICATIONS 11.1 Code of Federal Regulations: Not listed 11.2 NAB Hazard Rating for Bulk Water Transportation: <table border="1"> <thead> <tr> <th>Category</th> <th>Rating</th> </tr> </thead> <tbody> <tr> <td>Fire</td> <td>1</td> </tr> <tr> <td>Health</td> <td></td> </tr> <tr> <td>Vapor Irritant</td> <td>0</td> </tr> <tr> <td>Liquid or Solid Irritant</td> <td>0</td> </tr> <tr> <td>Poisons</td> <td>0</td> </tr> <tr> <td>Water Pollution</td> <td></td> </tr> <tr> <td>Human Toxicity</td> <td>1</td> </tr> <tr> <td>Aquatic Toxicity</td> <td>0</td> </tr> <tr> <td>Aesthetic Effect</td> <td>1</td> </tr> <tr> <td>Reactivity</td> <td></td> </tr> <tr> <td>Other Chemicals</td> <td>3</td> </tr> <tr> <td>Water</td> <td>1</td> </tr> <tr> <td>Self Reaction</td> <td>0</td> </tr> </tbody> </table> 11.3 NFPA Hazard Classification: <table border="1"> <thead> <tr> <th>Category</th> <th>Classification</th> </tr> </thead> <tbody> <tr> <td>Health Hazard (Blue)</td> <td>1</td> </tr> <tr> <td>Flammability (Red)</td> <td>1</td> </tr> <tr> <td>Reactivity (Yellow)</td> <td>0</td> </tr> </tbody> </table>		Category	Rating	Fire	1	Health		Vapor Irritant	0	Liquid or Solid Irritant	0	Poisons	0	Water Pollution		Human Toxicity	1	Aquatic Toxicity	0	Aesthetic Effect	1	Reactivity		Other Chemicals	3	Water	1	Self Reaction	0	Category	Classification	Health Hazard (Blue)	1	Flammability (Red)	1	Reactivity (Yellow)	0
Category	Rating																																						
Fire	1																																						
Health																																							
Vapor Irritant	0																																						
Liquid or Solid Irritant	0																																						
Poisons	0																																						
Water Pollution																																							
Human Toxicity	1																																						
Aquatic Toxicity	0																																						
Aesthetic Effect	1																																						
Reactivity																																							
Other Chemicals	3																																						
Water	1																																						
Self Reaction	0																																						
Category	Classification																																						
Health Hazard (Blue)	1																																						
Flammability (Red)	1																																						
Reactivity (Yellow)	0																																						
8. WATER POLLUTION 8.1 Aquatic Toxicity: Data not available 8.2 Waterford Toxicity: Data not available 8.3 Biological Oxygen Demand (BOD): Data not available 8.4 Feed Chain Concentration Potential: None		12. PHYSICAL AND CHEMICAL PROPERTIES 12.1 Physical State at 15°C and 1 atm: Liquid 12.2 Molecular Weight: 312 12.3 Boiling Point at 1 atm: 660°F = 360°C = 643°K 12.4 Freezing Point: Not pertinent 12.5 Critical Temperature: Not pertinent 12.6 Critical Pressure: Not pertinent 12.7 Specific Gravity: 1.12 at 20°C (liquid) 12.8 Liquid Surface Tension: Data not available 12.9 Liquid Water Interfacial Tension: Data not available 12.10 Vapor (Gas) Specific Gravity: Not pertinent 12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent 12.12 Latent Heat of Vaporization: Data not available 12.13 Heat of Combustion: -14,560 Btu/lb = -8,060 cal/g = -336 X 10 ³ J/kg 12.14 Heat of Decomposition: Not pertinent 12.15 Heat of Solution: Not pertinent 12.16 Heat of Polymerization: Not pertinent 12.17 Heat of Fusion: Data not available 12.18 Limiting Value: Data not available 12.19 Reid Vapor Pressure: Low																																					
9. SHIPPING INFORMATION 9.1 Grades of Purity: Commercial 9.2 Storage Temperature: Ambient 9.3 Inert Atmosphere: No requirement 9.4 Venting: Open		NOTES																																					

Occupational Health Guideline for Cadmium Dust (as Cadmium)*

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

APPLICABILITY

The general guidelines contained in this document apply to all cadmium dust. Physical and chemical properties of several specific compounds are provided for illustrative purposes.

SUBSTANCE IDENTIFICATION

Cadmium metal dust

- Formula: Cd
- Synonyms: None
- Appearance and odor: Odorless, gray powder.

Cadmium oxide dust

- Formula: CdO
- Synonyms: None
- Appearance and odor: Odorless, brown solid or blue-black solid.

Cadmium sulfide dust

- Formula: CdS
- Synonyms: Greenockite
- Appearance: Yellow-orange solid.

Cadmium chloride dust

- Formula: CdCl₂
- Synonyms: None
- Appearance: White solid.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for cadmium dust is 0.2 milligram of cadmium dust per cubic meter of air (mg/m³) averaged over an eight-hour work shift, with a ceiling level of 0.6 mg/m³. NIOSH has recommended that the permissible exposure limit be reduced to 40 micrograms of cadmium per cubic meter of air (μg/m³) averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling level of 200 μg/m³ averaged over a 15-minute period. The recommendations in this guideline supplement the recommendations in the NIOSH Criteria Document for Cadmium, which should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Cadmium dust can affect the body if it is inhaled. It can also affect the body if it is swallowed.

• Effects of overexposure

1. *Short-term Exposure:* Cadmium dust may cause irritation of the nose and throat. If enough has been inhaled, after a delay of several hours, a person may also develop cough, chest pain, sweating, chills, shortness of breath, and weakness. Death may occur. Ingestion of cadmium dust may cause nausea, vomiting, diarrhea, and abdominal cramps.

2. *Long-term Exposure:* Repeated or prolonged exposure to cadmium dust may cause loss of sense of smell, ulceration of the nose, shortness of breath (emphysema), kidney damage, and mild anemia. Exposure to cadmium has also been reported to cause an increased incidence of cancer of the prostate in man. Injections of cadmium sulfate in animals have been reported to cause malformation in their offspring.

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to cadmium dust.

• Recommended medical surveillance

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data—Cadmium metal dust

1. Molecular weight: 112.4
2. Boiling point (760 mm Hg): 767 C (1412 F)
3. Specific gravity (water = 1): 8.642
4. Vapor density (air = 1 at boiling point of cadmium metal dust): Not applicable
5. Melting point: 321 C (609 F)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F): Insoluble

8. Evaporation rate (butyl acetate = 1): Not applicable

• Physical data—Cadmium oxide dust

1. Molecular weight: 128.4
2. Boiling point (760 mm Hg): 900 C (1652 F) (sublimes and decomposes)
3. Specific gravity (water = 1): 6.95 or 8.15
4. Vapor density (air = 1 at boiling point of cadmium oxide dust): Not applicable
5. Melting point: 900 C (1652 F) (sublimes and decomposes)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F): 0.0005

8. Evaporation rate (butyl acetate = 1): Not applicable

• Physical data—Cadmium sulfide dust

1. Molecular weight: 144.5
2. Boiling point (760 mm Hg): Sublimes in N₂ at 980 C (1796 F)
3. Specific gravity (water = 1): 4.82
4. Vapor density (air = 1 at boiling point of cadmium sulfide dust): Not applicable
5. Melting point: 1750 C (3182 F) at 100 atm.
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F): 0.0001

8. Evaporation rate (butyl acetate = 1): Not applicable

• Physical data—Cadmium chloride dust

1. Molecular weight: 183
2. Boiling point (760 mm Hg): 960 C (1760 F)
3. Specific gravity (water = 1): 4.047
4. Vapor density (air = 1 at boiling point of cadmium chloride dust): Not applicable
5. Melting point: 568 C (1054 F)
6. Vapor pressure at 20 C (68 F): Essentially zero
7. Solubility in water, g/100 g water at 20 C (68 F): 140

8. Evaporation rate (butyl acetate = 1): Not applicable

• Reactivity

1. Conditions contributing to instability: None hazardous
2. Incompatibilities: Contact of cadmium metal dust with strong oxidizers or with elemental sulfur, selenium, and tellurium may cause fires and explosions.

3. Hazardous decomposition products: Toxic gases and vapors (such as cadmium oxide fume) may be released in a fire involving cadmium dust.

4. Special precautions: None

• Flammability

1. Flash point: Not applicable
2. Autoignition temperature: 250 C (482 F) (layer) (cadmium metal dust)

3. Minimum explosive dust concentration: Data not available

4. Extinguishant: Dry powder for metal fires

• Warning properties

Grant states that "cadmium is a very toxic metal which gives off fumes when burned or heated strongly. Characteristically these fumes cause dryness and irritation of the throat, followed in a few hours by nausea and diarrhea. Smarting of the eyes occurs relatively infrequently, and no injury to the eyes of human beings has been reported. Neither eye nor respiratory irritation is enough to prevent exposures which may cause serious systemic poisoning and damage to the lungs."

MONITORING AND MEASUREMENT PROCEDURES

• Eight-Hour Exposure Evaluation

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Ceiling Evaluation

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of cadmium dust. Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• Method

Sampling and analyses may be performed by collection of cadmium dust on a filter, followed by treatment with nitric acid, solution in hydrochloric acid, and atomic absorption spectrophotometric analysis. An analytical method for cadmium dust is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

ORIGINAL
(Red)

person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

- **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of releases until cleanup has been completed.

- If cadmium dust is released in hazardous concentrations, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of release.
3. Collect released material in the most convenient and safe manner for reclamation or for disposal in sealed containers in a secured sanitary landfill.

- **Waste disposal method:**

Cadmium dust may be disposed of in sealed containers in a secured sanitary landfill.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Cadmium Dust," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- American Industrial Hygiene Association: "Cadmium," *Hygienic Guide Series*, Detroit, Michigan, 1962.
- American National Standard Acceptable Concentrations - Cadmium Dust: ANSI-Z37.5-1970, American National Standards Institute, Inc., New York, 1970.
- Bonnell, J. A.: "Cadmium Poisoning," *Annals of Occupational Hygiene*, 8:45-49, 1965.
- Browning, E.: *Toxicity of Industrial Metals* (2nd ed.), Butterworths, London, 1969.
- Dunphy, B.: "Acute Occupational Cadmium Poisoning: A Critical Review of the Literature," *Journal of Occupational Medicine*, 9:22-26, 1967.
- Emmerson, B. T.: "'Ouch-Ouch' Disease: The Osteomalacia of Cadmium Nephropathy," *Annals of Internal Medicine*, 73:854-855, 1970.
- Fassett, D. W.: "Cadmium: Biological Effects and Occurrence in the Environment," *Annual Review of Pharmacology*, 15:425-435, 1975.

- Friberg, L., et al.: *Cadmium in the Environment*, (2nd ed.), CRC Press, Cleveland, 1974. (Red)

- Gleason, M. N., Gosselin, R. E., Hodge, H. C., and Smith, R. P.: *Clinical Toxicology of Commercial Products* (3rd ed.), Williams and Wilkins, Baltimore, 1969.

- Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.

- Gunn, S. A., et al.: "Specific Response of Mesenchymal Tissue to Cancerigenesis by Cadmium," *Archives of Pathology*, 83:493-499, 1967.

- Haddow, A., et al.: "Cadmium Neoplasia: Sarcomata at the Site of Injection of Cadmium Sulphate in Rats and Mice," *British Journal of Cancer*, 18:667-673, 1964.

- Heath, J. C., et al.: "Cadmium as a Carcinogen," *Nature*, 193:592-593, 1962.

- Holmberg, R. E., Jr., and Ferm, V. H.: "Interrelationships of Selenium, Cadmium, and Arsenic in Mamalian Teratogenesis," *Archives of Environmental Health*, 18:873-877, 1969.

- Karolinska Institute: *Cadmium in the Environment, II*, PB-221 198, prepared for Environmental Protection Agency, National Technical Information Service, Springfield, Virginia, 1973.

- Louri, D. B., et al.: "The Human Toxicity of Certain Trace Elements," *Annals of Internal Medicine*, 76:307-319, 1972.

- National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare: *Criteria for a Recommended Standard . . . Occupational Exposure to Cadmium*, HEW Publication No. (NIOSH) 76-192, GPO No. 017-033-00206-1, U.S. Government Printing Office, Washington, D.C., 1976.

- Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.

- Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.

- Stauden, A. (ex. ed.): *Kirk-Othmer Encyclopedia of Chemical Technology*, (2nd ed.), Interscience, New York, 1972.

- Tsuchiya, K.: "Proteinuria of Workers Exposed to Cadmium Fume," *Archives of Environmental Health*, 14:875-880, 1967.

* SPECIAL NOTE

The International Agency for Research on Cancer (IARC) has evaluated the data on these chemicals and has concluded that they cause cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 2, 1973, and Volume 11, 1976.

Occupational Health Guideline for Carbon Tetrachloride*

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: CCl_4
- Synonyms: Tetrachloromethane
- Appearance and odor: Colorless liquid with an ether-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for carbon tetrachloride is 10 parts of carbon tetrachloride per million parts of air (ppm) averaged over an eight-hour work shift, with an acceptable ceiling concentration of 25 ppm and a maximum allowable peak of 200 ppm for up to 5 minutes in any four-hour period. NIOSH has recommended that the permissible exposure limit be reduced to a ceiling level of 2 ppm averaged over a one-hour period, and that carbon tetrachloride be regulated as an occupational carcinogen. The NIOSH Criteria Document for Carbon Tetrachloride should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Carbon tetrachloride can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may be absorbed through the skin.

• Effects of overexposure

1. Short-term Exposure: Exposure to carbon tetrachloride may cause drowsiness, dizziness, incoordination, and unconsciousness. Delayed effects from short-term overexposure include damage to the heart, liver, and

kidneys. Symptoms of liver damage include yellow jaundice and dark urine. Eye contact with liquid carbon tetrachloride causes burning and intense irritation.

2. Long-term Exposure: Prolonged or repeated exposure may cause liver and kidney damage. Repeated or prolonged contact of the liquid with the skin may cause skin irritation.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to carbon tetrachloride.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to carbon tetrachloride at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of liver and kidneys should be stressed. The skin and eyes should be examined for evidence of chronic disorders.

—Liver function tests: Carbon tetrachloride causes liver damage. A profile of liver function should be obtained using a medically acceptable array of biochemical tests.

—Urinalysis: Since kidney damage has also been observed from exposure, a urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

• Summary of toxicology

Carbon tetrachloride vapor is a narcotic and causes severe damage to the liver and kidneys. In animals the primary damage from intoxication is to the liver, but in humans the majority of fatalities have been the result of renal injury with secondary cardiac failure. In humans, liver damage occurs more often after ingestion of the

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid carbon tetrachloride.
- Clothing wet with liquid carbon tetrachloride should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of carbon tetrachloride from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the carbon tetrachloride, the person performing the operation should be informed of carbon tetrachloride's hazardous properties.
- Non-impervious clothing which becomes contaminated with liquid carbon tetrachloride should be removed promptly and not reworn until the carbon tetrachloride is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where liquid carbon tetrachloride may contact the eyes.

SANITATION

- Skin that becomes wet with liquid carbon tetrachloride should be promptly washed or showered with soap or mild detergent and water to remove any carbon tetrachloride.
- Eating and smoking should not be permitted in areas where carbon tetrachloride is handled, processed, or stored.

- Employees who handle liquid carbon tetrachloride should wash their hands thoroughly with soap or mild detergent and water before eating or smoking. (Red)
- Areas in which exposure to carbon tetrachloride can occur should be identified by signs or other appropriate means, and access to these areas should be limited to authorized persons.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to carbon tetrachloride may occur and control methods which may be effective in each case:

Operation	Controls
Use in manufacture of fluorocarbons for aerosols, refrigerants, and fire extinguishants	Material substitution; process enclosure; local exhaust ventilation; personal protective equipment
Use as an agricultural grain fumigant and pesticide	Material substitution; personal protective equipment
Use in polymer technology as reaction medium, catalyst, chain transfer agent, and solvent for resins; in organic synthesis for chlorination of organic compounds in soap perfumery and insecticide industries	Process enclosure; local exhaust ventilation
Use as an industrial solvent for rubber cements, cable and semiconductor manufacture, separation of xylene isomers as components to reduce flammability	Material substitution; process enclosure; local exhaust ventilation; personal protective equipment
Use as a laboratory solvent	Material substitution; personal protective equipment
Use in metal recovery and catalyst regeneration	Process enclosure; local exhaust ventilation

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If carbon tetrachloride gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present

*** SPECIAL NOTE**

The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 1, 1972.

ORIGINAL
(Red)

RESPIRATORY PROTECTION FOR CARBON TETRACHLORIDE

Condition	Minimum Respiratory Protection* Required Above 10 ppm
Vapor Concentration	
100 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
300 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 300 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for Soluble Chromic and Chromous Salts (as Chromium)*

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

APPLICABILITY

The general guidelines contained in this document apply to all soluble chromic and chromous salts. Physical and chemical properties of several specific compounds are provided for illustrative purposes.

SUBSTANCE IDENTIFICATION

Chromic sulfate hydrate

- Formula: $\text{Cr}_2(\text{SO}_4)_3 \cdot 16\text{H}_2\text{O}$ (approximately)
- Synonyms: None
- Appearance and odor: Violet or green, odorless solid.

Chromic potassium sulfate

- Formula: $\text{KCr}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$
- Synonyms: Potassium chrome alum; potassium chromium (III) sulfate
- Appearance and odor: Red-violet, odorless solid.

Chromous chloride

- Formula: CrCl_2
- Synonyms: None
- Appearance and odor: Colorless to gray, odorless solid.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for soluble chromic or chromous salts is 0.5 milligrams of soluble chromic or

chromous salts (as chromium) per cubic meter of air (mg/m^3) averaged over an eight-hour work shift. Certain forms of chromium (VI) have been found to cause increased respiratory cancer among workers. Certain other forms of chromium (VI) are currently believed to be non-carcinogenic: They are the monochromates and bichromates (dichromates) of hydrogen, lithium, sodium, potassium, rubidium, cesium, and ammonium, and chromium (VI) oxide (chromium acid anhydride). NIOSH has not conducted an in-depth study of the toxicity of chromium metal or compounds containing chromium in an oxidation state other than 6. NIOSH recommends that the permissible exposure limit for carcinogenic chromium (VI) compounds be reduced to $0.001 \text{ mg}/\text{m}^3$ and that these compounds be regulated as occupational carcinogens. NIOSH also recommends that the permissible exposure limit for non-carcinogenic chromium (VI) be reduced to $0.025 \text{ Cr (VI) mg}/\text{m}^3$ averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling level of $0.05 \text{ Cr (VI) mg}/\text{m}^3$ averaged over a 15-minute period. It is further recommended that chromium (VI) in the workplace be considered carcinogenic, unless it has been demonstrated that only the non-carcinogenic chromium (VI) compounds mentioned above are present. The NIOSH Criteria Documents for Chromic Acid and Chromium (VI) should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Soluble chromic or chromous salts can affect the body if they come in contact with the eyes or skin. They can also affect the body if they are swallowed.

• Effects of overexposure

Exposure to certain soluble chromic or chromous salts have been reported to cause an allergic skin rash.

• Reporting signs and symptoms

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to soluble chromic or chromous salts.

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

mous salts. Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• **Method**

Sampling and analyses may be performed by collection of soluble chromic or chromous salts on a filter, followed by treatment with acid and atomic absorption spectrophotometric analysis. An analytical method for soluble chromic and chromous salts is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 6, 1980, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00369-6).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquids or solids containing soluble chromic or chromous salts.

• Clothing contaminated with soluble chromic or chromous salts should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of chromic or chromous salts from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the chromic or chromous salts, the person performing the operation should be informed of soluble chromic or chromous salts's hazardous properties.

• Non-impervious clothing which becomes contaminated with soluble chromic or chromous salts should be removed promptly and not reworn until the soluble chromic or chromous salts are removed from the clothing.

• Employees should be provided with and required to use dust- and splash-proof safety goggles where there is any possibility of liquids or solids containing soluble chromic or chromous salts contacting the eyes.

• Where there is any possibility that employees' eyes may be exposed to liquids or solids containing soluble chromic or chromous salts, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

• Skin that becomes contaminated with soluble chromic or chromous salts should be promptly washed or showered to remove any soluble chromic or chromous salts.

• Employees who handle liquids or solids containing soluble chromic or chromous salts should wash their hands thoroughly before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to soluble chromic or chromous salts may occur and control methods which may be effective in each case:

Operation	Controls
Use in textile treatment in dyeing, printing, moth-proofing, and water-proofing; use in tanning of leather in gloves, garments, and shoe uppers	Local exhaust ventilation; personal protective equipment
Use in manufacture of pigments for green varnishes, inks, paints, and glazes	Local exhaust ventilation; personal protective equipment
Use for metal treatment and polishing	Local exhaust ventilation; personal protective equipment
Use in photographic fixing baths for hardening of emulsions; use as catalysts and in manufacture of catalysts	Local exhaust ventilation; personal protective equipment
Use in chemical synthesis; use as corrosion inhibitors	Local exhaust ventilation; personal protective equipment

*** SPECIAL NOTE**

The International Agency for Research on Cancer (IARC) has evaluated the data on these chemicals and has concluded that they cause cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 2, 1973, and Volume 23, 1980.

RESPIRATORY PROTECTION FOR SOLUBLE CHROMIC AND CHROMOUS SALTS (AS CHROMIUM)

Condition	Minimum Respiratory Protection* Required Above 0.5 mg/m ³
Particulate Concentration	
2.5 mg/m ³ or less	Any dust and mist respirator, except single-use.**
5 mg/m ³ or less	Any dust and mist respirator, except single-use or quarter-mask respirator.** Any fume respirator or high efficiency particulate respirator.** Any supplied-air respirator.** Any self-contained breathing apparatus.**
25 mg/m ³ or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
250 mg/m ³ or less	A powered air-purifying respirator with a full facepiece and a high efficiency particulate filter. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 250 mg/m ³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

*Only NIOSH-approved or MSHA-approved equipment should be used.

**If eye irritation occurs, full-facepiece respiratory protective equipment should be used.

Occupational Health Guideline for Copper Dusts and Mists

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formulas of example compounds: $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$; CuCl
- Example compounds: Copper sulfate dust or mist; cuprous chloride dust
- Appearance and odor: Odorless solids

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for copper dusts or mists is 1 milligram of copper dusts or mists per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

- **Routes of exposure**
Copper dusts or mists can affect the body if they are inhaled or if they come in contact with the eyes or skin. They can also affect the body if they are swallowed.
- **Effects of overexposure**
 1. *Short-term Exposure:* Powdered copper or dusts or mists of copper salts may cause a feeling of illness similar to the common cold with sensations of chills and stuffiness of the head. Small copper particles may enter the eye and cause irritation, discoloration, and damage.
 2. *Long-term Exposure:* Repeated or prolonged exposure to copper dusts or mists may cause skin irritation or discoloration of the skin or hair.
 3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to copper dusts or mists.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to copper dusts and mists at potentially hazardous levels:

1. *Initial Medical Screening:* Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from copper dusts and mists exposure.

—Chronic respiratory disease: Copper dusts or mists cause respiratory irritation in animals. In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of copper dusts or mists might cause exacerbation of symptoms due to their irritant properties.

—Liver disease: Copper dusts or mists cause liver damage in animals. Persons with pre-existing liver disease may be more susceptible to the effects of these agents.

—Kidney disease: Copper dusts or mists cause kidney damage in animals. The importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Skin disease: Skin sensitization in human subjects has occurred. Persons with pre-existing skin disorders may be more susceptible to the effects of these agents.

—Hematopoietic disorders: Anemia has occurred in animals given copper salts orally. Persons with pre-existing blood disorders may be more susceptible to the effects of these agents.

—Wilson's disease: Persons with pre-existing Wilson's disease may be more susceptible to the effects of these agents.

2. *Periodic Medical Examination:* Any employee developing the above-listed conditions should be referred for further medical examination.

• Summary of toxicology

Inhalation of dusts and mists of copper and copper salts results in irritation of the upper respiratory tract, with occasional ulceration and perforation of the nasal septum. Inhalation of copper and its compounds by animals caused injury to the lungs and liver with

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with copper salts or liquids containing copper salts.

- If employees' clothing may have become contaminated with powdered copper, copper salts, or liquids containing copper salts, employees should change into uncontaminated clothing before leaving the work premises.

- Clothing contaminated with copper salts should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of copper salts from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the copper salts, the person performing the operation should be informed of copper salts' hazardous properties.

- Non-impervious clothing which becomes contaminated with copper salts should be removed promptly and not reworn until the copper salts are removed from the clothing.

- Employees should be provided with and required to use dust- and splash-proof safety goggles where powdered copper or dusts, mists, or liquids containing copper salts may contact the eyes.

SANITATION

- Skin that becomes contaminated with copper salts should be promptly washed or showered with soap or mild detergent and water to remove any copper salts.

- Eating and smoking should not be permitted in areas where powdered copper, copper salts, or liquids containing copper salts are handled, processed, or stored.

- Employees who handle powdered copper, copper salts, or liquids containing copper salts should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to copper dusts or mists may occur and control methods which may be effective in each case:

Operation	Controls
Liberation during mining, extracting, and refining copper ore; during fabrication and manufacture of copper rod, wire, piping, and tubing for use in electrical, plumbing, and building industries; during manufacture of domestic utensils; during manufacture of alloys	Local exhaust ventilation; general dilution ventilation; personal protective equipment

Operation

Liberation from production and application of fungicides, insecticides, and germicides for soil, feed, grain, textile, water and sewage treatments; during use of copper salts for paint pigments and coloring agents, electroplating baths, wood preservation, automotive emission controls, textile treatment, and organic synthesis

Controls

Local exhaust ventilation; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If copper dusts or mists get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with these chemicals.

• Skin Exposure

If copper salts or liquids containing copper salts get on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If copper salts or liquids containing copper salts penetrate through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of copper dusts or mists, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When powdered copper, copper salts, or liquids containing copper salts have been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and

RESPIRATORY PROTECTION FOR COPPER DUSTS AND MISTS

ORIGINAL
(REV)

Condition	Minimum Respiratory Protection* Required Above 1 mg/m ³
Particulate Concentration	
50 mg/m ³ or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
2000 mg/m ³ or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 2000 mg/m ³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for Cyanide

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

APPLICABILITY

The general guidelines contained in this document apply to all cyanides. Physical and chemical properties of two specific compounds are provided for illustrative purposes.

SUBSTANCE IDENTIFICATION

Potassium cyanide

- Formula: KCN
- Synonyms: None
- Appearance and odor: White solid with a faint almond odor.

Sodium cyanide

- Formula: NaCN
- Synonyms: None
- Appearance and odor: White solid with a faint almond odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for cyanide is 5 milligrams of cyanide per cubic meter of air (mg/m^3) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit be changed to a ceiling of 5 milligrams cyanide per cubic meter of air averaged over a 10-minute period. The NIOSH Criteria Document for Hydrogen Cyanide and Cyanide Salts should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Cyanide can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. Sufficient cyanide may be absorbed through the skin, especially if there are cuts to cause fatal poisoning.

• Effects of overexposure

1. *Short-term Exposure:* Inhalation or ingestion of cyanide salts may be rapidly fatal. Larger doses by inhalation or swallowing may cause the person to rapidly lose consciousness, stop breathing, and die. In some cases, there are convulsions. At lower levels of exposure, the earlier symptoms include weakness, headache, confusion, nausea, and vomiting. These symptoms may be followed by unconsciousness and death. Occasionally, convulsions occur. Milder forms of intoxication may result only in weakness, dizziness, headache, and nausea. The dust of cyanide salts is irritating to the eyes. In the presence of tears, it may cause the symptoms of poisoning described above. The dust of cyanide salts may produce irritation of the nose and skin. Strong solutions of cyanide salts are corrosive and may produce ulcers.

2. *Long-term Exposure:* Effects from chronic exposure to cyanide are non-specific and rare.

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to cyanide.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to cyanide at potentially hazardous levels:

1. *Initial Medical Examination:*

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a history of fainting spells, such as occur in various types of cardiovascular and nervous disorders,

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

explosions. Contact with acids and acid salts causes immediate formation of toxic and flammable hydrogen cyanide gas.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen cyanide and carbon monoxide) may be released when cyanide decomposes.

4. Special precautions: Cyanide may react with carbon dioxide in ordinary air to form toxic hydrogen cyanide gas.

- **Flammability**

1. Not combustible

- **Warning properties**

1. Odor Threshold: No quantitative information is available concerning the odor threshold of sodium or potassium cyanide. HCN, however, is evolved from these substances in the presence of moisture. The Manufacturing Chemists Association states that "although HCN has a characteristic odor, its toxic action at hazardous concentrations is so rapid that it is of no value as a warning property."

2. Eye Irritation Level: Cyanide (as CN) is not known to be an eye irritant. However, according to Grant, HCN can produce eye irritation after chronic exposures.

3. Evaluation of Warning Properties: Although cyanide (as CN) has a negligible vapor pressure, in the presence of moisture HCN can be given off. HCN does not have adequate warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- **Eight-Hour Exposure Evaluation**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Ceiling Evaluation**

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of cyanide. Each measurement should consist of a ten (10) minute sample or series of consecutive samples totalling ten (10) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

- **Method**

Sampling and analyses may be performed by collection of cyanide with a cellulose membrane filter and an impinger containing sodium hydroxide, followed by analysis by direct potentiometry. An analytical method for cyanide is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with cyanide or liquids containing cyanide.

- If employees' clothing has had any possibility of being contaminated with cyanide, employees should change into uncontaminated clothing before leaving the work premises.

- Clothing which has had any possibility of being contaminated with cyanide should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of cyanide from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the cyanide, the person performing the operation should be informed of cyanide's hazardous properties.

- Where there is any possibility of exposure of an employee's body to cyanide or liquids containing cyanide, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

- Non-impervious clothing which becomes contaminated with cyanide should be removed immediately and not reworn until the cyanide is removed from the clothing.

- Employees should be provided with and required to use dust- and splash-proof safety goggles where there is any possibility of cyanide or liquids containing cyanide contacting the eyes.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.

• If cyanide is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. Collect spilled material in the most convenient and safe manner for reclamation, or for treatment in a cyanide disposal system.

• Waste disposal method:

After treatment as in above, cyanide may be disposed of in a secured sanitary landfill.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Cyanide (as CN)," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- American Industrial Hygiene Association: "Hydrogen Cyanide," *Hygienic Guide Series*, Detroit, Michigan, 1970.
- Baskin, A. D. (ed.): *Handling Guide for Potentially Hazardous Commodities*, Railway Systems and Management Association, Chicago, 1972.
- Chen, K. K., and Rose, C. L.: "Nitrite and Thiosulfate Therapy in Cyanide Poisoning," *Journal of the American Medical Association*, 149:113-119, 1952.
- Deichmann, W. B., and Gerarde, H. W.: *Toxicology of Drugs and Chemicals*, Academic Press, New York, 1969.
- Gleason, M. N., Gosselin, R. E., Hodge, H. C., and Smith, R. P.: *Clinical Toxicology of Commercial Products*

(3rd ed.), Williams and Wilkins, Baltimore, 1969.

- Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.
- Hamilton, A., and Hardy, H.: *Industrial Toxicology* (3rd ed.), Publishing Sciences Group, Acton, Massachusetts, 1974.
- Hunter, D.: *Diseases of Occupations* (4th ed.), Little, Brown, Boston, 1969.
- Kirk, R., and Othmer, D.: *Encyclopedia of Chemical Technology* (2nd ed.), Interscience, New York, 1968.
- Manufacturing Chemists Association, Inc.: *Chemical Safety Data Sheet SD-30, Cyanide*, Washington, D.C., 1967.
- National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare: *Criteria for a Recommended Standard . . . Occupational Exposure to Hydrogen Cyanide and Cyanide Salts*, HEW Publication No. (NIOSH) 77-108, GPO No. 017-033-00163-4, U.S. Government Printing Office, Washington, D.C., 1976.
- Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.
- Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.
- Stauden, A. (exec. ed.): *Kirk-Othmer Encyclopedia of Chemical Technology* (2nd ed.), Interscience, New York, 1972.
- Stecher, P. G. (ed.): *The Merck Index* (8th ed.), Merck Co., Inc., Rahway, New Jersey, 1968.
- Thienes, C. H., and Haley, T. J.: *Clinical Toxicology* (5th ed.), Lea and Febiger, Philadelphia, 1972.
- von Oettingen, W. F.: *Poisoning: A Guide to Clinical Diagnosis and Treatment* (2nd ed.), Saunders, Philadelphia, 1958.
- Wolfsie, J. H.: "Treatment of Cyanide Poisoning in Industry," *A.M.A. Archives of Industrial Hygiene and Occupational Medicine*, 4:417-425, 1951.

Occupational Health Guideline for Dibutylphthalate

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $C_6H_4(CO_2C_4H_9)_2$
- Synonyms: DBP; dibutyl 1,2-benzenedicarboxylate
- Appearance and odor: Colorless, oily liquid with a very weak, aromatic odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for dibutylphthalate is 5 milligrams of dibutylphthalate per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

• Routes of exposure

Dibutylphthalate can affect the body if it is swallowed, comes in contact with the eyes or skin, or is inhaled as a mist or spray.

• Effects of overexposure

Swallowing dibutylphthalate may cause nausea, dizziness, light sensitivity, and watering and redness of the eyes. Overexposure to hot vapors or mists of dibutylphthalate may cause nose and throat irritation.

• Reporting signs and symptoms

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to dibutylphthalate.

• Recommended medical surveillance

Routine medical examinations should be provided to each employee who is exposed to dibutylphthalate at potentially hazardous levels.

• Summary of toxicology

Extensive experience with dibutylphthalate as an insect repellent has shown that it is relatively non-irritating to the skin, eyes, and mucous membranes. Aerosols from heated dibutylphthalate may cause irritation of the eyes and upper respiratory tract. In one report of a human case, accidental ingestion of ten grams of this compound by a chemical operator produced nausea and dizziness with lacrimation, photophobia, and conjunctivitis, but recovery was prompt and uneventful. Animal experiments to determine dermal and oral toxicity of dibutylphthalate showed that extremely high doses were considered necessary to produce toxic effects. Dibutylphthalate was found to be teratogenic by intraperitoneal injection of doses representing $\frac{1}{10}$, $\frac{1}{2}$, and $\frac{1}{3}$ of the LD50 value into female rats at the 5th, 10th, and 15th day of gestation. This probably is of no significance in industrial exposures.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 278
2. Boiling point (760 mm Hg): 335 C (635 F)
3. Specific gravity (water = 1): 1.05
4. Vapor density (air = 1 at boiling point of dibutylphthalate): 9.6
5. Melting point: -37 C (-35 F)
6. Vapor pressure at 20 C (68 F): Less than 0.01 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.45
8. Evaporation rate (butyl acetate = 1): Almost zero

• Reactivity

1. Conditions contributing to instability: None
2. Incompatibilities: Contact with nitrates, strong oxidizers, strong alkalies, and strong acids may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving dibutylphthalate.

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

Operation

Controls

Liberation during forming of ethyl cellulose articles; during production of polyvinyl acetate; during production of cellulose acetate butyrate, cellulose acetate propionate, and polyvinyl acetate adhesives

General dilution ventilation

Liberation during brush application of nitrocellulose surface coatings; during manufacture of polyester and epoxy resins; during manufacture of nitrocellulose surface coatings

General dilution ventilation

Liberation during manufacture of explosives and propellants

Local exhaust ventilation

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If dibutylphthalate gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention if any discomfort continues. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If dibutylphthalate saturates the clothing, remove and clean the clothing before wearing it again. Wash any dibutylphthalate from the skin regularly, particularly when there has been much skin contact. If there is skin irritation, get medical attention.

• Breathing

If a person breathes in large amounts of dibutylphthalate, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When dibutylphthalate has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept

with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing respiratory protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If dibutylphthalate is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and atomized in a suitable combustion chamber.

• Waste disposal methods:

Dibutylphthalate may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

2. By atomizing in a suitable combustion chamber.

REFERENCES

• American Conference of Governmental Industrial Hygienists: "Dibutylphthalate," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.

• Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.

• Karel, L., et al.: "The Intraperitoneal Toxicity of Some Glycols, Glycol Ethers, Glycol Esters, and Phthalates in Mice," *Journal of Pharmacology and Experimental Therapeutics*, 90:338-347, 1947.

• Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.

• Singh, A. R., et al.: "Teratogenicity of Phthalate Esters in Rats," *Journal of Pharmaceutical Sciences*, 61:51-55, 1972.

• Union Carbide Corporation, Industrial Medicine and Toxicology Department: *Toxicology Studies - Dibutylphthalate*, New York, 1971.

Occupational Health Guideline for o-Dichlorobenzene

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: 1,2- $C_6H_4Cl_2$
- Synonyms: 1,2-Dichlorobenzene; o-dichlorobenzol
- Appearance and odor: Colorless to pale yellow liquid with a pleasant aromatic odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for o-dichlorobenzene is a ceiling of 50 parts of o-dichlorobenzene per million parts of air (ppm). This may also be expressed as 300 milligrams of o-dichlorobenzene per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

o-Dichlorobenzene can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may also be absorbed through the skin.

• Effects of overexposure

1. *Short-term Exposure:* o-Dichlorobenzene vapor may cause irritation of the upper respiratory tract and eyes. Higher concentrations may cause drowsiness, unconsciousness, and death. The liquid may cause burning of the skin. The liquid may also cause burning of the eyes with tissue damage.

2. *Long-term Exposure:* Prolonged or repeated contact with o-dichlorobenzene may cause skin irritation. Prolonged or repeated inhalation of high concentrations of vapor might cause liver or kidney injury.

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to o-dichlorobenzene.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to o-dichlorobenzene at potentially hazardous levels:

1. *Initial Medical Screening:* Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from o-dichlorobenzene exposure.

—Liver disease: o-Dichlorobenzene is known as a liver toxin in animals. The importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Kidney disease: o-Dichlorobenzene is known as a kidney toxin in animals. The importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Skin disease: o-Dichlorobenzene may cause sensitization dermatitis and blistering of the skin. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

2. *Periodic Medical Examination:* Any employee developing the above-listed conditions should be referred for further medical examination.

• Summary of toxicology

o-Dichlorobenzene vapor at high concentrations is toxic to the liver and kidneys in animals. Rats died from exposure to 977 ppm for 7 hours, but survived when exposed for only 2 hours; animals survived exposure to 539 ppm for 3 hours and at necropsy showed marked centrilobular necrosis of the liver, as well as cloudy swelling of the tubular epithelium of the kidneys. Several species of animals exposed repeatedly to 93 ppm for 7 hours daily showed no adverse effects. The liquid instilled in the rabbit eye produced apparent distress and slight conjunctival irritation. Eye irritation is not

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

- Non-impervious clothing which becomes contaminated with liquid o-dichlorobenzene should be removed promptly and not reworn until the o-dichlorobenzene is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where liquid o-dichlorobenzene may contact the eyes.

SANITATION

- Skin that becomes contaminated with liquid o-dichlorobenzene should be promptly washed or showered with soap or mild detergent and water to remove any o-dichlorobenzene.
- Employees who handle liquid o-dichlorobenzene should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to o-dichlorobenzene may occur and control methods which may be effective in each case:

Operation	Controls
Use in cleaning and degreasing of metal, leather, wool, paper, dry cleaning, brick, and upholstery	General dilution ventilation; personal protective equipment
Use as fumigant for poultry houses and stockyards for termites, moths, and beetles	Personal protective equipment
Use in application or removal of surface coatings	General dilution ventilation; personal protective equipment
Use in maintenance of equipment containing heat-transfer agents	Personal protective equipment
Use in organic synthesis in pesticides, herbicides, dyestuffs, and pharmaceuticals; chemical intermediate in manufacture of toluene-diisocyanate and extractive distillation of ethyl benzene from xylene; use as a deodorizing agent	General dilution ventilation

Operation

Use in textile dyeing operations

Controls

Local exhaust ventilation; general dilution ventilation; personal protective equipment

ORIGINAL
(Red)

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If liquid o-dichlorobenzene gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If liquid o-dichlorobenzene gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If liquid o-dichlorobenzene soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of o-dichlorobenzene, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

When o-dichlorobenzene has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.
- If o-dichlorobenzene is spilled or leaked, the following steps should be taken:
 1. Remove all ignition sources.

RESPIRATORY PROTECTION FOR o-DICHLOROBENZENE

ORIGINAL
(Red)

Condition	Minimum Respiratory Protection* Required Above 50 ppm
Vapor Concentration	
1000 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s).
1700 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 1700 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for 1,1-Dichloroethane

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: CH_3CHCl_2
- Synonyms: Asymmetrical dichloroethane; ethylidene chloride; 1,1-ethylidene dichloride
- Appearance and odor: Colorless liquid with a chloroform-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for 1,1-dichloroethane is 100 parts of 1,1-dichloroethane per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 400 milligrams of 1,1-dichloroethane per cubic meter of air (mg/m^3). The American Conference of Governmental Industrial Hygienists has recommended for 1,1-dichloroethane a Threshold Limit Value of 200 ppm.

HEALTH HAZARD INFORMATION

• Routes of exposure

1,1-Dichloroethane can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

• Effects of overexposure

1. Short-term Exposure: Breathing 1,1-dichloroethane vapor may cause drowsiness and unconsciousness. It might also cause damage to the liver, kidneys, and lungs. Splashing the liquid in the eyes may cause irritation.

2. Long-term Exposure: Prolonged, confined, or repeated skin contact with 1,1-dichloroethane can produce a slight burn.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to 1,1-dichloroethane.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to 1,1-dichloroethane at potentially hazardous levels:

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from 1,1-dichloroethane exposure.

—Skin disease: 1,1-Dichloroethane can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Liver disease: Although 1,1-dichloroethane is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Kidney disease: Although 1,1-dichloroethane is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of 1,1-dichloroethane might cause exacerbation of symptoms due to its irritant properties.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

• Summary of toxicology

1,1-Dichloroethane vapor is a narcotic. Rats exposed to 32,000 ppm for 30 minutes did not survive. The most consistent findings in animals exposed to concentrations

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

reworn until the 1,1-dichloroethane is removed from the clothing.

- Employees should be provided with and required to use splash-proof safety goggles where liquid 1,1-dichloroethane may contact the eyes.

SANITATION

- Skin that becomes wet with liquid 1,1-dichloroethane should be immediately washed or showered with soap or mild detergent and water to remove any 1,1-dichloroethane.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to 1,1-dichloroethane may occur and control methods which may be effective in each case:

Operation	Controls
Use as dewaxer of mineral oils; extractant for heat-sensitive substances	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use as a fumigant	General dilution ventilation of work area; personal protective equipment
Use in manufacture of vinyl chloride by vapor phase cracking; use in manufacture of high vacuum rubber and silicon grease; use as a chemical intermediate	General dilution ventilation; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If 1,1-dichloroethane gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If 1,1-dichloroethane gets on the skin, promptly flush the contaminated skin using soap or mild detergent and water. If 1,1-dichloroethane soaks through the clothing, remove the clothing immediately and flush the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of 1,1-dichloroethane, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration.

Keep the affected person warm and at rest. Get medical attention as soon as possible. ^{ORIGINAL}
(Red)

• Swallowing

When 1,1-dichloroethane has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

- If 1,1-dichloroethane is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. 1,1-Dichloroethane should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of 1,1-dichloroethane vapors are permitted.

- Waste disposal method:

1,1-Dichloroethane may be disposed of by atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "1,1-Dichloroethane (Ethylidene Chloride)," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- American Industrial Hygiene Association: "1,1-Dichloroethane (Ethylidene Chloride)," *Hygienic Guide Series*, Detroit, Michigan, 1971.

Summary

2,4-Dimethylphenol has been shown to act as a cancer promoter in skin-painting studies, but it has not been tested for carcinogenicity in a complete bioassay. It is an ATP blocking agent. Other dimethylphenols have been shown to cause pathological changes in the heart, liver, and kidneys.

CAS Number: 105-67-9

Chemical Formula: $(\text{CH}_3)_2\text{C}_6\text{H}_3\text{OH}$

IUPAC Name: 2,4-Dimethyl-1-hydroxybenzene

Important Synonyms and Trade Names: m-Xylenol, cresylic acid,
2,4-xylenol

Chemical and Physical Properties

Molecular Weight: 122.2

Boiling Point: 210°C

Melting Point: 27°C

Specific Gravity: 0.956 at 20°C

Solubility in Water: 17 g/liter

Solubility in Organics: Freely soluble in alcohol, chloroform,
ether, and benzene

Log Octanol/Water Partition Coefficient: 2.50

Vapor Pressure: 0.06 mm Hg at 20°C

pKa: 10.60

Transport and Fate

Photooxidation is probably the primary mechanism for removal of 2,4-dimethylphenol in clear, aerated surface waters, although metal-catalyzed oxidation, sorption, and biodegradation may also have some effect. In murky, unaerated water, biodegradation is

2,4-Dimethylphenol

Page 1

October 1985

Acute toxicity: No available data
Chronic toxicity: No available data

ORIGINAL
(Red)

Human Health

Health criterion: No available data
Organoleptic criterion: 400 µg/liter

REFERENCES

- NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH). 1983. Registry of Toxic Effects of Chemical Substances. Data Base. Washington, D.C. October 1983
- U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1979. Water-Related Environmental Fate of 129 Priority Pollutants. Washington, D.C. December 1979. EPA 440/4-79-029
- U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1980. Ambient Water Quality Criteria for 2,4-Dimethylphenol. Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. October 1980. EPA 440/5-80-028
- WEAST, R.E., ed. 1981. Handbook of Chemistry and Physics. 62nd ed. CRC Press, Cleveland, Ohio. 2,332 pages

Occupational Health Guideline for Ethyl Benzene

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $C_2H_5C_6H_5$
- Synonyms: Phenylethane; ethylbenzol
- Appearance and odor: Colorless liquid with an aromatic odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for ethyl benzene is 100 parts of ethyl benzene per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 435 milligrams of ethyl benzene per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

• Routes of exposure

Ethyl benzene can affect the body if it is inhaled, is swallowed, or comes in contact with the eyes or skin.

• Effects of overexposure

1. *Short-term Exposure:* Ethyl benzene causes irritation of the eyes, nose, throat, and skin. With exposure to high concentrations, irritating effects are more pronounced, and a person may begin to feel weak, dizzy, drowsy, and become unconscious.

2. *Long-term Exposure:* Prolonged or repeated ethyl benzene exposure of the skin may cause skin rash.

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to ethyl benzene.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to ethyl benzene at potentially hazardous levels:

1. *Initial Medical Screening:* Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from ethyl benzene exposure.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of ethyl benzene might cause exacerbation of symptoms due to its irritant properties or psychic reflex bronchospasm.

—Kidney disease: Although ethyl benzene is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with possible impairment of renal function.

—Liver disease: Although ethyl benzene is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Skin disease: Ethyl benzene is a defatting agent and can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

2. *Periodic Medical Examination:* Any employee developing the above-listed conditions should be referred for further medical examination.

• Summary of toxicology

Ethyl benzene is primarily an irritant of skin and, to some degree, of eyes and upper respiratory tract. Systemic absorption causes depression of the central nervous system with narcosis at very high concentrations. Aspiration of small amounts causes extensive edema and hemorrhage of lung tissue. It is readily metabolized and excreted chiefly as mandelic acid in the urine.

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

SANITATION

- Skin that becomes contaminated with liquid ethyl benzene should be promptly washed or showered with soap or mild detergent and water to remove any ethyl benzene.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to ethyl benzene may occur and control methods which may be effective in each case:

Operation	Controls
Liberation during manufacture of styrene monomer	Local exhaust ventilation
Use during spray application of vinyl resin surface coating	Local exhaust ventilation; personal protective equipment
Liberation during manufacture of paints, varnishes, and other surface coatings	Local exhaust ventilation; general dilution ventilation
Use in manufacture and application of rubber adhesives	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use during electroplating of aluminum on copper or steel	Local exhaust ventilation for open-surface tanks
Liberation during oven baking and drying of surface coatings	Local exhaust ventilation for ovens
Liberation during application of surface coatings by dipping, flow coatings, and roller coating	Local exhaust ventilation
Liberation during use as an intermediate in dye manufacture	General dilution ventilation
Use as a heat-transfer medium; use as a dielectric	General dilution ventilation; personal protective equipment
Liberation during production of acetophenone by oxidation of ethyl benzene	General dilution ventilation

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If ethyl benzene gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If ethyl benzene gets on the skin, promptly flush the contaminated skin with water. If ethyl benzene soaks through the clothing, remove the clothing immediately and flush the skin with water. When there is skin irritation, get medical attention.

• Breathing

If a person breathes in large amounts of ethyl benzene, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Swallowing

If ethyl benzene has been swallowed, do not induce vomiting. Get medical attention immediately.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

- If ethyl benzene is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and atomized in a suitable combustion chamber. Combustion may be improved by mixing with a more flammable liquid. Ethyl benzene should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.

- Waste disposal methods:

Ethyl benzene may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

Summary

bis(2-Ethylhexyl)phthalate (DEHP) is probably persistent in the environment. It is carcinogenic in rats and mice, causing hepatocellular carcinomas. Teratogenic and reproductive effects have been observed in experimental animals. Chronic exposure to DEHP retarded growth and increased liver and kidney weights in animals.

CAS Number: 117-81-7

Chemical Formula: $C_{26}H_{44}(COOCH_2CH(C_2H_5)C_4H_9)_2$

IUPAC Name: bis(2-Ethylhexyl)ester phthalic acid

Important Synonyms and Trade Names: DEHP, Di(2-ethylhexyl)phthalate, bis(2-ethylhexyl)ester phthalic acid

Chemical and Physical Properties

Molecular Weight: 391.0

Boiling Point: 386.9°C at 5 mm Hg

Melting Point: -50°C

Specific Gravity: 1.985

Solubility in Water: 0.4 mg/liter at 25°C

Solubility in Organics: Miscible with mineral oil and hexane

Log Octanol/Water Partition Coefficient: 5.3

Vapor Pressure: 2×10^{-7} mm Hg at 20°C

Flash Point: 218.33°C

Transport and Fate

bis(2-Ethylhexyl)phthalate (DEHP) is the most thoroughly studied of the phthalate esters. It probably hydrolyzes in surface waters, but at such a slow rate that this process is not environmentally significant under most conditions. Photo-

bis(2-Ethylhexyl)phthalate

Page 1

October 1985

DEHP is mutagenic when injected intraperitoneally. However, most experiments conducted with microorganisms and mammalian cells have failed to demonstrate genotoxic activity. Teratogenic and fetotoxic effects have been observed in experimental animals after oral and intraperitoneal administration. Other reproductive effects, including testicular changes in rats and mice, have also been reported. ORIGINAL (Red)

DEHP appears to have a relatively low toxicity in experimental animals. The oral, intraperitoneal, and intravenous LD₅₀ values reported for DEHP in rats are 31 g/kg, 30.7 g/kg, and 0.25 g/kg, respectively. DEHP is poorly absorbed through the skin, and no irritant response or sensitizing potential from dermal application has been noted in experimental animals or humans.

Chronic exposure to relatively high concentrations of DEHP in the diet has caused retardation of growth and increased liver and kidney weights in experimental animals.

Toxicity to Wildlife and Domestic Animals

Acute median effect values ranged from 1,000 to 11,100 µg/liter DEHP for the freshwater cladoceran Daphnia magna. The LC₅₀ values for the midge, scud, and bluegill all exceeded the highest concentrations tested, which were 18,000, 32,000, and 770,000 µg/liter, respectively. As these values are greater than the water solubility of the chemical, it is unlikely that DEHP will be acutely toxic to organisms in natural waters. In a chronic toxicity test with Daphnia magna, significant reproductive impairment was found at the lowest concentration tested, 3 µg/liter. A chronic toxicity value of 8.4 µg/liter was reported for the rainbow trout. No acute or chronic values were reported for saltwater invertebrates or vertebrates. Reported bioconcentration factors for DEHP in fish and invertebrates range from 14 to 2,680.

Although insufficient data were presented to calculate the acute-chronic ratio for DEHP, it is apparently on the order of 100 to 1,000. Therefore, acute exposure to the chemical is unlikely to affect aquatic organisms adversely, but chronic exposure may have detrimental effects on the environment.

Regulations and Standards

Ambient Water Quality Criteria (USEPA):

Aquatic Life

The available data are not adequate for establishing criteria

bis(2-Ethylhexyl)phthalate

Page 3

October 1985

 Clement Associates

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
P.O. BOX 1436, SCHENECTADY, NY 12301 USA
(518) 385-2577



No. 357

ISOPHORONE

Revision B

Date July 1979

SECTION I. MATERIAL IDENTIFICATION

Reviewed: December 1979

MATERIAL NAME: ISOPHORONE

OTHER DESIGNATIONS: 3,5,5-Trimethyl-2-cyclohexen-1-one, ASTM D2916,
GE Material D5B65, CAS # 000 078 591

MANUFACTURER: Available from many suppliers, including:

Union Carbide Corp.
Chemicals and Plastics Div.
270 Park Ave., NY, NY 10017

SECTION II. INGREDIENTS AND HAZARDS

Isophorone

%

ca 100

HAZARD DATA

8-hr TWA 25 ppm*
or 140 mg/m³Rat, oral LD₅₀
2330 mg/kgRabbit, skin LD₅₀
1500 mg/kg

*Current OSHA level. ACGIH (1978) recommended a ceiling level of 5 ppm. NIOSH (1978) has proposed a 10-hr TWA of 4 ppm or 23 mg/m³.

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg F (C) — 419 (215) . Specific gravity (H₂O=1) — 0.92
Vapor density (Air=1) — 4.7 Volatiles, % — ca 100
Vapor pressure @ 38°C, mm Hg — 1 Melting point, deg C — -8.1
Solubility in water — Slight Molecular weight — 138.2
(ca 1.2%)

Appearance & Odor: A colorless, clear liquid with peppermint-like or camphor-like odor.
Unfatigued, odor recognition threshold (100% of test panel) is 0.54 ppm in air.

SECTION IV. FIRE AND EXPLOSION DATA

LOWER UPPER

Flash Point and Method

Autoignition Temp.

Flammability Limits In Air

205°F OC

864°F

% by Volume

0.8

3.8

Extinguishing media: CO₂, dry chemical, alcohol foam or water mist or spray for a smothering effect. Use a water spray to cool fire-exposed containers and to flush solvent away from hazardous exposures.

This material is a moderate fire and explosion hazard when heated or exposed to flame. Use self-contained breathing apparatus in fighting fires in which this material is involved; eye protection required.

SECTION V. REACTIVITY DATA

This liquid is stable and unreactive at room temperature; it will not polymerize. It can react with oxidizing materials such as nitric or sulfuric acid. Store away from these and other strong oxidizing materials.

Oxidation products in air include oxides of carbon and nitrogen.

It has been reported that isophorone will readily undergo autoxidation to produce peroxides. (Ref. 25, pg 154)

OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR INORGANIC LEAD

INTRODUCTION

"Inorganic lead" is defined as lead oxides, metallic lead, and lead salts (including organic salts such as lead soaps but excluding lead arsenate). This guideline summarizes pertinent information about inorganic lead for workers, employers, and occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; therefore, readers are advised to regard these recommendations as general guidelines.

SUBSTANCE IDENTIFICATION

- **Formula:** Pb
- **Synonyms:** C.I. pigment metal 4, C.I. 77575, KS-4, lead flake, lead S2
- **Identifiers:** CAS 7439-92-1; RTECS OF7525000; DOT 1794
- **Appearance and odor:** Bluish-white, silvery, or gray odorless solid

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
 1. Molecular weight: 207.19
 2. Boiling point (at 760 mmHg): 1,740°C (3,164°F)
 3. Specific gravity (water = 1): 11.34
 4. Melting point: 327.5°C (621.5°F)
 5. Insoluble in water
- **Reactivity**
 1. Incompatibilities: Lead reacts vigorously with oxidizing materials. Contact with hydrogen peroxide or active metals such as sodium or potassium may cause fires or explosions.
 2. Hazardous decomposition products: Toxic fumes (e.g., lead oxide) may be released in a fire involving inorganic lead.
- **Flammability**
 1. Extinguishant: Dry sand, dry dolomite, or dry graphite
 2. Caution: Lead is combustible in powder form when exposed to heat or flame

• Warning properties

Evaluation of warning properties for respirator selection: Based on lack of information on odor threshold and eye irritation levels, inorganic lead should be treated as a chemical with poor warning properties.

EXPOSURE LIMITS

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for inorganic lead is 50 micrograms of lead per cubic meter of air ($\mu\text{g}/\text{m}^3$) as a time-weighted average (TWA) concentration over an 8-hour workshift. If a worker is exposed to lead for more than 8 hours in any workday, the PEL, as a TWA for that day, shall be reduced according to the following formula: maximum permissible limit (in $\mu\text{g}/\text{m}^3$) = 400 divided by hours worked in the day. The National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit (REL) is 100 $\mu\text{g}/\text{m}^3$ as a TWA for up to a 10-hour workshift, 40-hr. workweek. The American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV®) is 0.15 mg/m^3 (150 $\mu\text{g}/\text{m}^3$) as a TWA for a normal 8-hour workday and a 40-hour workweek (Table 1).

**Table 1.—Occupational exposure limits
for inorganic lead**

	Exposure units $\mu\text{g}/\text{m}^3$
OSHA PEL TWA	50
NIOSH REL TWA	100*
ACGIH TLV® TWA	150

* Air level to be maintained such that worker blood lead remains $\leq 60 \mu\text{g}/100\text{g}$.

HEALTH HAZARD INFORMATION

• Routes of exposure

Inorganic lead may cause adverse health effects following exposure via inhalation or ingestion.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health
Division of Standards Development and Technology Transfer

latency, the need for medical surveillance may extend well beyond termination of employment.

- **Sentinel health events**

1. Acute SHE's include: Acute renal failure.
2. Delayed-onset or reproductive SHE's include: Inflammatory and toxic neuropathy and chronic renal failure.

MONITORING AND MEASUREMENT PROCEDURES

- **TWA exposure evaluation**

Measurements to determine worker exposure to inorganic lead should be taken so that the TWA exposure is based on a single entire workshift sample or an appropriate number of consecutive samples collected during the entire workshift. Under certain conditions, it may be appropriate to collect several short-term interval samples (up to 30 minutes each) to determine the average exposure level. Air samples should be taken in the worker's breathing zone (air that most nearly represents that inhaled by the worker).

- **Method**

Sampling and analysis may be performed by collecting inorganic lead with cellulose membrane filters followed by acid digestion and analysis by atomic absorption. A detailed sampling and analytical method for inorganic lead may be found in the *NIOSH Manual of Analytical Methods* (method number 7082).

PERSONAL PROTECTIVE EQUIPMENT

Chemical protective clothing (CPC) should be selected after utilizing available performance data, consulting with the manufacturer, and then evaluating the clothing under actual use conditions.

Workers should be provided with and required to use CPC, gloves, face shields (8-inch minimum) and other appropriate protective clothing necessary to prevent skin contact with inorganic lead.

Workers should be provided with and required to use dust-proof safety goggles where inorganic lead may come in contact with the eyes.

SANITATION

Clothing which is contaminated with inorganic lead should be removed immediately and placed in closed containers for storage until it can be discarded or until provision is made for the removal of inorganic lead from the clothing. If the clothing is to be laundered or cleaned, the person performing the operation should be informed of inorganic lead's hazardous properties.

Change and shower rooms should be provided with separate locker facilities for street and work clothes.

Skin that becomes contaminated with inorganic lead should be promptly washed with soap and water.

The storage, preparation, dispensing, or consumption of food or beverages, the storage or application of cosmetics, the

storage or smoking of tobacco or other smoking materials, or the storage or use of products for chewing should be prohibited in work areas. ORIGINAL (Red)

Workers who handle inorganic lead should wash their faces, hands, and forearms thoroughly with soap and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

Common operations in which exposure to inorganic lead may occur and control methods which may be effective in each case are listed in Table 2.

Table 2.—Operations and methods of control for inorganic lead

Operations	Controls
During primary (ore) and secondary (scrap) smelting of lead; during the manufacture of storage batteries; during typecasting and remelting of type metal in printing	Process enclosure, local exhaust ventilation, dust control, personal protective equipment
During soldering in the fabrication of metal articles	Process enclosure, local exhaust ventilation, personal protective equipment
During melting and pouring of lead and alloys containing lead; during welding, burning, and cutting of metal structures containing lead or painted with lead containing surface coatings	Local exhaust ventilation, personal protective equipment
During the use of lead in the manufacture of surface coatings, including paints and varnishes; during the manufacture of ceramics and glass	Local exhaust ventilation, personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, remove the victim from further exposure, send for medical assistance, and initiate emergency procedures.

- **Eye exposure**

Where there is any possibility of a worker's eyes being exposed to inorganic lead, an eye-wash fountain should be provided within the immediate work area for emergency use.

If inorganic lead gets into the eyes, flush them immediately with large amounts of water for 15 minutes, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this compound.

- Leidel, N.A., Busch, K.A., and Lynch, J.R.: *Occupational Exposure Sampling Strategy Manual*, U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 77-173, Cincinnati, 1977.
- Levy, B.S., and Wegman, D.H. (eds.): *Occupational Health: Recognizing and Preventing Work-Related Disease*, Little, Brown and Company, Boston, 1983.
- Mark, H.F., Othmer, D.F., Overberger, C.G., Seaborg, G.T., Grayson, M., and Eckroth, D. (eds.): *Kirk-Othmer Encyclopedia of Chemical Technology* (3rd ed.), John Wiley & Sons, Inc., New York, 1981.
- National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control: *Criteria for a Recommended Standard... Occupational Exposure to Inorganic Lead—Revised Criteria 1978*, DHEW (NIOSH) Publication No. 78-158, Cincinnati, 1978.
- National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control: *NIOSH Manual of Analytical Methods* (3rd ed., Vol. 2), Eller, P.M. (ed.), DHHS (NIOSH) Publication No. 84-100, Cincinnati, 1984.
- National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control: *Registry of Toxic Effects*

of Chemical Substances (Microfiche Edition), Sweet, D.V., and Lewis, R.J. (eds.), Cincinnati, April 1985.

- Proctor, N.H., and Hughes, J.P.: *Chemical Hazards of the Workplace*, J.B. Lippincott Company, Philadelphia, 1978.
- Rom, W.N. (ed.): *Environmental and Occupational Medicine*, Little, Brown and Company, Boston, 1983.
- Rothstein, M.A.: *Medical Screening of Workers*, Bureau of National Affairs, Washington, DC, 1984.
- Rutstein, D.D., Mullan, R.J., Frazier, T.M., Halperin, W.E., Melius, J.M., and Sestito, J.P.: "Sentinel Health Events (Occupational): A Basis for Physician Recognition and Public Health Surveillance," *American Journal of Public Health*, 73:1054-1062, 1983.
- Sax, N.I. (ed.): *Dangerous Properties of Industrial Materials* (6th ed.), Van Nostrand Reinhold Company, New York, 1984.
- Scientific Assembly on Environmental and Occupational Health: "Evaluation of Impairment/Disability Secondary to Respiratory Disease," *American Review of Respiratory Diseases*, 126:945-951, 1982.
- Scientific Assembly on Environmental and Occupational Health: "Surveillance for Respiratory Hazards in the Occupational Setting," *American Review of Respiratory Diseases*, 126:952-956, 1982.
- Weast, R.C. (ed.): *CRC Handbook of Chemistry and Physics* (64th ed.), CRC Press, Inc., Boca Raton, Florida, 1983.
- Windholz, M. (ed.): *The Merck Index* (10th ed.), Merck & Co., Inc., Rahway, New Jersey, 1983.

ORIGINAL
(Red)

Occupational Health Guideline for Inorganic Mercury

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: Hg.
- Synonyms: Quicksilver
- Appearance and odor: Silvery, mobile, odorless liquid.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for mercury is a ceiling level of 0.1 milligram of mercury per cubic meter of air (mg/m^3). NIOSH has recommended that the permissible exposure limit be changed to 0.05 mg/m^3 averaged over an eight-hour work shift. The NIOSH Criteria Document for Inorganic Mercury should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Mercury can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It may enter the body through the skin.

• Effects of overexposure

1. Short-term Exposure: Inhaled mercury vapor may cause headaches, cough, chest pains, chest tightness, and difficulty in breathing. It may also cause chemical pneumonitis. In addition, it may cause soreness of the mouth, loss of teeth, nausea, and diarrhea. Liquid mercury may irritate the skin.

2. Long-term Exposure: Repeated or prolonged exposure to mercury liquid or vapor causes effects which develop gradually. The first effects to occur are often

fine shaking of the hands, eyelids, lips, tongue, or jaw. Other effects are allergic skin rash, headache, sores in the mouth, sore and swollen gums, loose teeth, insomnia, excess salivation, personality change, irritability, indecision, loss of memory, and intellectual deterioration.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to mercury.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to mercury at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a history of allergies or known sensitization to mercury, chronic respiratory disease, nervous system disorders, or kidney disease would be expected to be at increased risk from exposure. Examination for any signs or symptoms of unacceptable mercury absorption such as weight loss, insomnia, tremors, personality changes, or other evidence of central nervous system involvement, as well as evidence of kidney damage, should be stressed. The skin should be examined for evidence of chronic disorders.

—Urinalysis: Since kidney damage has been observed in humans exposed to mercury, a urinalysis should be obtained to include, at a minimum, specific gravity, albumin, glucose, and a microscopic on centrifuged sediment. Determination of mercury level in urine may be helpful in assessing extent of absorption.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid mercury.
- If employees' clothing may have become contaminated with mercury, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing contaminated with mercury should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of mercury from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the mercury, the person performing the operation should be informed of mercury's hazardous properties.
- Non-impervious clothing which becomes contaminated with mercury should be removed promptly and not reworn until the mercury is removed from the clothing.

SANITATION

- Workers subject to skin contact with liquid mercury should wash with soap or mild detergent and water any areas of the body which may have contacted mercury at the end of each work day.
- Skin that becomes contaminated with mercury should be promptly washed or showered with soap or mild detergent and water to remove any mercury.
- Eating and smoking should not be permitted in areas where mercury is handled, processed, or stored.
- Employees who handle mercury should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to mercury may occur and control methods which may be effective in each case:

Operation

Use as a liquid cathode in electrolytic production of chlorine and caustic soda from brine

Use during manufacture and repair of industrial and medical apparatus; use during manufacture of inorganic and organic compounds for use as pesticides, antiseptics, germicides, and skin preparations, and miscellaneous applications as chemical intermediates, preservatives, and pigments

Use in preparation of amalgams for use in tooth restorations, chemical processing, and molding operations; use during manufacture of mildew-proof paints and marine antifouling agents

Use in manufacture of organic mercurials; use in manufacture of batteries, lamps, and power tubes; manufacture of tungsten-molybdenum wire and rods; use in manufacture of inorganic salts for use as catalysts in production of urethanes, vinyl chloride monomers, anthraquinone derivatives, and other miscellaneous chemicals

Controls

General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment; meticulous housekeeping

General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment; meticulous housekeeping

General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment

General dilution ventilation; process enclosure; local exhaust ventilation; personal protective equipment; meticulous housekeeping

Smith, R. P.: *Clinical Toxicology of Commercial Products* (3rd ed.), Williams and Wilkins, Baltimore, 1969.

• Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.

• Hunter, D.: *Diseases of Occupations* (4th ed.), Little, Brown, Boston, 1969.

• International Labour Office: *Encyclopedia of Occupational Health and Safety*, McGraw-Hill, New York, 1971.

• Kirk, R., and Othmer, D.: *Encyclopedia of Chemical Technology* (2nd ed.), Interscience, New York, 1968.

• *Mercury Poisoning*, Occupational Health Technical Information Service, California State Department of Public Health, 1963.

• National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare: *Criteria for a Recommended Standard . . . Occupational Exposure to Inorganic Mercury*, HEW Publication No. HSM 73-11024, GPO No. 017-033-00022, U.S. Government Printing Office, Washington, D.C., 1973.

• Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.

• Vostal, J. J., and Clarkson, T. W.: "Mercury as an Environmental Hazard," *Journal of Occupational Medicine*, 15:649-656, 1973.

• "Working with Mercury in Industry," U.S. Department of Health, Education, and Welfare Pamphlet, U.S. Government Printing Office, Washington, D.C., 1973.

RESPIRATORY PROTECTION FOR INORGANIC MERCURY

Condition	Minimum Respiratory Protection* Required Above 0.1 mg/m ³
Particulate or Vapor Concentration	
1 mg/m ³ or less	Any supplied-air respirator. Any self-contained breathing apparatus.
5 mg/m ³ or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
28 mg/m ³ or less	A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 28 mg/m ³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against mercury. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for Methylene Chloride

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: CH_2Cl_2
- Synonyms: Dichloromethane; methylene dichloride
- Appearance and odor: Colorless liquid with an odor like chloroform.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for methylene chloride is 500 parts of methylene chloride per million parts of air (ppm) averaged over an eight-hour work shift, with an acceptable ceiling level of 1000 ppm and a maximum peak concentration of 2000 ppm for 5 minutes in any two-hour period. NIOSH has recommended that the permissible exposure limit be reduced to 75 ppm averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling level of 500 ppm averaged over a 15-minute period. NIOSH further recommends that permissible levels of methylene chloride be reduced where carbon monoxide is present. The NIOSH Criteria Document for Methylene Chloride should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Methylene chloride can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

• Effects of overexposure

1. *Short-term Exposure:* Methylene chloride is an anesthetic. Inhaling the vapor may cause mental confusion,

light-headedness, nausea, vomiting, and headache. Continued exposure may cause increased light-headedness, staggering, unconsciousness, and death. High vapor concentrations may also cause irritation of the eyes and respiratory tract. Exposure to this chemical may make the symptoms of angina worse. Skin exposure to the liquid may cause irritation. If the liquid is held in contact with the skin, it may cause skin burns. Splashes of the liquid into the eyes may cause irritation.

2. *Long-term Exposure:* Prolonged or repeated exposure to methylene chloride may cause irritation of the skin.

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to methylene chloride.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to methylene chloride at potentially hazardous levels:

1. *Initial Medical Examination:*

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the employee at increased risk, and to establish a baseline for future health monitoring. Examination of the skin, liver, kidneys, cardiovascular system, and blood should be stressed. Clinical impressions of the autonomic nervous system and pulmonary function should be made, with additional tests conducted where indicated.

—Skin disease: Methylene chloride can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Liver function test: Methylene chloride causes liver damage in animals and this justifies consideration before exposing persons with impaired liver function. A profile of liver function should be obtained by utilizing a medically acceptable array of biochemical tests.

—Kidney disease: Methylene chloride causes kidney damage in animals and this justifies special considera-

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

• Ceiling Evaluation

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of methylene chloride. Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• Peak Above Ceiling Evaluation

Measurements to determine employee peak exposure should be taken during periods of maximum expected airborne concentration of methylene chloride. Each measurement should consist of a 30-minute sample or a series of consecutive samples totalling 30 minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• Method

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure methylene chloride may be used. An analytical method for methylene chloride is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT ^{ORIGINAL (Red)}

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid methylene chloride.
- Non-impervious clothing which becomes wet with liquid methylene chloride should be removed promptly and not reworn until the methylene chloride is removed from the clothing.
- Employees should be provided with and required to use splash-proof safety goggles where liquid methylene chloride may contact the eyes.

SANITATION

- Skin that becomes wet with liquid methylene chloride should be promptly washed or showered with soap or mild detergent and water to remove any methylene chloride.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to methylene chloride may occur and control methods which may be effective in each case:

Operation	Controls
Use as a solvent in paint and varnish removers; manufacture of aerosols; cold cleaning and ultrasonic cleaning; and as an extraction solvent for foods and furniture processing	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use as a cooling solvent in manufacture of cellulose acetate; in organic synthesis; and in plastics processing	Process enclosure; local exhaust ventilation
Use as a solvent in vapor degreasing of thermal switches and thermometers	Process enclosure; local exhaust ventilation
Use as a secondary refrigerant in air conditioning and scientific testing	General dilution ventilation; local exhaust ventilation; personal protective equipment

ton, D.C., 1976.

• Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.

• Reinhardt, C. F., et al.: "Epinephrine-Induced Cardiac Arrhythmia Potential of Some Common Industrial Solvents," *Journal of Occupational Medicine*, 15:953-955, 1973.

• Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.

• Spector, W. S. (Vols. I, II), Negherbon, W. O. (Vol. III), Grebe, R. M. (Vol. IV), and Dittmer, D. S. (Vol. V) (eds.): *Handbook of Toxicology*, Saunders, Philadelphia, 1956-1959.

• Stecher, P. G. (ed.): *The Merck Index* (8th ed.), Merck Co., Inc., Rahway, New Jersey, 1968.

• Stewart, R. D., and Dodd, H. C.: "Absorption of Carbon Tetrachloride, Trichloroethylene, Tetrachloroethylene, Methylene Chloride, and 1,1,1-Trichloroethane through the Human Skin," *Industrial Hygiene Journal*, Sept. - Oct., 1964, p. 439.

• Stewart, R. D., et al.: "Experimental Human Exposure to Methylene Chloride," *Archives of Environmental Health*, 25:342-348, 1972.

• Summer, W.: *Odor Pollution of Air: Causes and Control*, L. Hill, London, 1975.

• Thienes, C. H., and Haley, T. J.: *Clinical Toxicology* (5th ed.), Lea and Febiger, Philadelphia, 1972.

RESPIRATORY PROTECTION FOR METHYLENE CHLORIDE

Condition

Minimum Respiratory Protection* Required Above 500 ppm

Vapor Concentration

5000 ppm or less

Any supplied-air respirator with a full facepiece, helmet, or hood.

Any self-contained breathing apparatus with a full facepiece.

Greater than 5000 ppm or entry and escape from unknown concentrations

Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.

Fire Fighting

Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

Escape

Any gas mask providing protection against organic vapors.

Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for Naphthalene

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $C_{10}H_8$
- Synonyms: White tar; naphthalin
- Appearance and odor: Colorless to brown solid with the odor of mothballs.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for naphthalene is 10 parts of naphthalene per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 50 milligrams of naphthalene per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- Routes of exposure
Naphthalene can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may enter the body through the skin.
- Effects of overexposure
 1. *Short-term Exposure:* Inhalation or ingestion of naphthalene may cause abdominal cramps, nausea, vomiting, diarrhea, headache, tiredness, confusion, painful urination, and bloody or dark urine. Swallowing large amounts may cause convulsions or coma. Inhalation, ingestion, and possibly skin absorption of naphthalene may cause destruction of red blood cells with anemia, fever, yellow jaundice, bloody urine, kidney and liver damage. Naphthalene, on contact with the eyes, has produced irritation. Naphthalene, on contact with the skin, has produced skin irritation.

2. *Long-term Exposure:* Repeated skin exposure to naphthalene may cause an allergic rash. Repeated exposure may cause cataracts.

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to naphthalene.

- Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to naphthalene at potentially hazardous levels:

1. *Initial Medical Examination:*

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a deficiency of glucose-6-phosphate dehydrogenase in erythrocytes may be at increased risk from exposure. Examination of the eyes, blood, liver and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

—A complete blood count: Naphthalene has been shown to cause red blood cell hemolysis. A complete blood count should be performed, including a red cell count, a white cell count, and a differential count of a stained smear, as well as hemoglobin and hematocrit.

—Urinalysis: Since kidney damage may also occur from exposure to naphthalene, a urinalysis should be performed, including at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

2. *Periodic Medical Examination:* The aforementioned medical examinations should be repeated on an annual basis.

- Summary of toxicology

Naphthalene vapor causes hemolysis and eye irritation; it may cause cataracts. Severe intoxication from ingestion of the solid results in characteristic manifestations of marked intravascular hemolysis and its consequences, including potentially fatal hyperkalemia. Initial symptoms include eye irritation, headache, confu-

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with naphthalene or liquids containing naphthalene.
- If employees' clothing may have become contaminated with solid naphthalene, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing contaminated with naphthalene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of naphthalene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the naphthalene, the person performing the operation should be informed of naphthalene's hazardous properties.
- Non-impervious clothing which becomes contaminated with naphthalene should be removed promptly and not reworn until the naphthalene is removed from the clothing.
- Employees should be provided with and required to use dust- and splash-proof safety goggles where solid naphthalene or liquids containing naphthalene may contact the eyes.

SANITATION

- Skin that becomes contaminated with naphthalene should be promptly washed or showered with soap or mild detergent and water to remove any naphthalene.
- Eating and smoking should not be permitted in areas where solid naphthalene is handled, processed, or stored.
- Employees who handle naphthalene or liquids containing naphthalene should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to naphthalene may occur and control methods which may be effective in each case:

Operation	Controls
Formulation of insecticide and moth repellant as flakes, powder, balls, or cakes	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use as a fumigant for moth repellant and insecticide	General dilution ventilation; personal protective equipment

Operation

Use in manufacture of chemical intermediates for production of pharmaceuticals, resins, dyes, plasticizers, solvents, coatings, insecticides, pigments, rubber chemicals, tanning agents, surfactants, waxes, cable coatings, textile spinning lubricants, rodenticides, and in storage batteries

Manufacture of naphthalene

Controls ORIGINAL (Red)

Local exhaust ventilation; general dilution ventilation; personal protective equipment

Local exhaust ventilation; process enclosure; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If naphthalene or liquids containing naphthalene get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If molten naphthalene gets on the skin, immediately flush the skin with large amounts of water. Get medical attention immediately. If naphthalene or liquids containing naphthalene get on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If naphthalene or liquids containing naphthalene penetrate through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of naphthalene, move the exposed person to fresh air at once.

• Swallowing

When naphthalene has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify some-

RESPIRATORY PROTECTION FOR NAPHTHALENE

Condition	Minimum Respiratory Protection* Required Above 10 ppm
Particulate and Vapor Concentration	
500 ppm or less	A chemical cartridge respirator with a full facepiece, organic vapor cartridge(s), and dust filter. A gas mask with a chin-style or a front- or back-mounted organic vapor canister and dust filter. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 500 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors and particulates. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for Nickel Metal and Soluble Nickel Compounds

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

APPLICABILITY

The general guidelines contained in this document apply to all soluble nickel compounds. Physical and chemical properties of several specific compounds are provided for illustrative purposes.

SUBSTANCE IDENTIFICATION

Nickel, metallic

- Formula: Ni
- Synonyms: Nickel catalyst; Raney nickel
- Appearance and odor: Silvery gray, metallic (or darker), odorless powder.

Nickel nitrate hexahydrate

- Formula: $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$
- Synonyms: None
- Appearance and odor: Green, odorless solid.

Nickel sulfate hexahydrate

- Formula: $\text{NiSO}_4 \cdot 6\text{H}_2\text{O}$
- Synonyms: None
- Appearance and odor: Green, odorless solid.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for nickel metal and soluble nickel compounds is 1 milligram of nickel metal

and soluble nickel compounds per cubic meter of air (mg/m^3) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit for nickel be reduced to $0.015 \text{ mg}/\text{m}^3$ averaged over a work shift of up to 10 hours per day, 40 hours per week, and that nickel be regulated as an occupational carcinogen. The NIOSH Criteria Document for Inorganic Nickel and the Special Occupational Hazard Review for Nickel Carbonyl should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Metallic nickel or soluble nickel compounds can affect the body if they are inhaled or if they come in contact with the eyes or skin. They can also affect the body if they are swallowed.

• Effects of overexposure

Nickel fumes are respiratory irritants and may cause pneumonitis. Skin contact may cause an allergic skin rash. Nickel and its compounds have been reported to cause cancer of the lungs and sinuses. Nickel itself is not very toxic if swallowed, but its soluble salts are quite toxic and, if swallowed, may cause giddiness and nausea. Exposure to nickel carbonyl (by inhalation or skin absorption) may cause both initial and delayed symptoms. Initial symptoms include headache, dizziness, shortness of breath, and vomiting. These symptoms generally disappear when the worker is exposed to fresh air. The delayed symptoms may develop 12 to 36 hours after exposure. The shortness of breath returns, a blue color of the skin may appear, and a fever may develop. The exposed person may become delirious. In some cases the symptoms may run together. Death may occur.

• Reporting signs and symptoms

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to nickel metal and soluble nickel compounds.

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Contact with sulfur may cause evolution of heat. Contact of nickel nitrate with wood and other combustibles may cause fire.

3. Hazardous decomposition products: Toxic gases and vapors (such as nickel carbonyl and oxides of nitrogen) may be released in a fire involving nickel or in the decomposition of nickel compounds.

4. Special precautions: None

• **Flammability**

1. Flash point: Not applicable

2. Minimum ignition temperature: Not available

3. Minimum explosive concentration: Not available, but nickel sponge catalyst may ignite spontaneously in air.

4. Extinguishant: Dry powder, dry sand, dry dolomite, dry graphite

• **Warning properties**

Grant states that "workers employed in nickel plating involving nickel sulfate, sulfuric acid, and chlorine are said to have developed conjunctivitis and epiphora when ventilation was poor." Since, according to Grant, "both sulfuric acid mist and chlorine gas are known to cause burning and stinging of the eyes," and since the *AIHA Hygienic Guide* states that eye contact "does not present any problem peculiar to nickel," nickel metal and soluble compounds are not treated as eye irritants.

MONITORING AND MEASUREMENT PROCEDURES

• **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• **Method**

Sampling and analyses may be performed by collection on a cellulose membrane filter followed by treatment with nitric and perchloric acids, solution in nitric acid, and analysis with an atomic absorption spectrophotometer. An analytical method for nickel metal and soluble nickel compounds is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 5, 1979, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00349-1), number PB 258 433).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not

technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with powdered metallic nickel or solids or liquids containing soluble nickel compounds.

• If employees' clothing may have become contaminated with powdered metallic nickel or solid soluble nickel compounds, employees should change into uncontaminated clothing before leaving the work premises.

• Clothing contaminated with metallic nickel or soluble nickel compounds should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of metallic nickel or soluble nickel compounds from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the metallic nickel or soluble nickel compounds, the person performing the operation should be informed of these substances' hazardous properties.

• Non-impervious clothing which becomes contaminated with metallic nickel or soluble nickel compounds should be removed promptly and not reworn until the metallic nickel or soluble nickel compounds are removed from the clothing.

SANITATION

• Skin that becomes contaminated with metallic nickel or soluble nickel compounds should be promptly washed or showered with soap or mild detergent and water to remove any metallic nickel or soluble nickel compounds.

• Eating and smoking should not be permitted in areas where solids or liquids containing soluble nickel compounds are handled, processed, or stored.

• Employees who handle powdered metallic nickel or solids or liquids containing soluble nickel compounds should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

• Areas in which exposure to nickel metal and soluble nickel compounds may occur should be identified by

2. Collect spilled material in the most convenient and safe manner for reclamation or for disposal in a secured sanitary landfill. Liquid containing nickel should be absorbed in vermiculite, dry sand, earth, or a similar material.

• Waste disposal method:

Nickel metal and soluble nickel compounds may be disposed of in sealed containers in a secured sanitary landfill.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Nickel Ni," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- American Industrial Hygiene Association: "Nickel (Except the Carbonyls)," *Hygienic Guide Series*, Detroit, Michigan, 1966.
- Browning, E.: *Toxicity of Industrial Metals* (2nd ed.), Butterworths, London, 1969.
- Committee on Medical and Biologic Effects of Environmental Pollutants, Division of Medical Sciences, National Research Council: *Nickel*, National Academy of Sciences, Washington, D.C., 1975.

ORIGINAL
Red)
• Gleason, M. N., Gosselin, R. E., Hodge, H. C., and Smith, R. P.: *Clinical Toxicology of Commercial Products* (3rd ed.), Williams and Wilkins, Baltimore, 1969.

- Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.
- Hamilton, A., and Hardy, H.: *Industrial Toxicology* (3rd ed.), Publishing Sciences Group, Acton, Massachusetts, 1974.
- McConnell, L. H., et al.: "Asthma Caused by Nickel Sensitivity," *Annals of Internal Medicine*, 78:888-89
- National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare: *Criteria for a Recommended Standard . . . Occupational Exposure to Inorganic Nickel*, HEW Publication No. (NIOSH) 77-164, GPO No. 017-033-00219-3, U.S. Government Printing Office, Washington, D.C., 1977.
- National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare: *NIOSH Special Occupational Hazard Review for Nickel Carbonyl*, HEW Publication No. (NIOSH) 77-184, U.S. Government Printing Office, Washington, D.C., 1977.
- Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.
- von Oettingen, W. F.: *Poisoning: A Guide to Clinical Diagnosis and Treatment* (2nd ed.), Saunders, Philadelphia, 1958.

* SPECIAL NOTE

Nickel metal and soluble nickel compounds appear on the OSHA "Candidate List" of chemicals being considered for further scientific review regarding their carcinogenicity (*Federal Register*, Vol. 45, No. 157, pp. 5372-5379, 12 August 1980).

The International Agency for Research on Cancer (IARC) has evaluated the data on these chemicals and has concluded that they cause cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 11, 1976.

Occupational Health Guideline for Phenol

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: C_6H_5OH
- Synonyms: Carboic acid; monohydroxybenzene
- Appearance and odor: Colorless to pink solid or thick liquid with a characteristic, sweet, tarry odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for phenol is 5 parts of phenol per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 19 milligrams of phenol per cubic meter of air (mg/m^3). NIOSH has recommended that the permissible exposure limit be changed to 20 mg/m^3 averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling of 60 mg/m^3 averaged over a 15-minute period. The NIOSH Criteria Document for Phenol should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Phenol can affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed. It may enter the body through the skin.

• Effects of overexposure

1. Short-term Exposure: Phenol has a marked corrosive effect on any tissue. When it comes in contact with the eyes, it may cause severe damage and blindness. On contact with the skin, it does not cause pain but causes a whitening of the exposed area. If the chemical is not removed promptly, it may cause a severe burn or

systemic poisoning. Systemic effects may occur from any route of exposure, especially after skin contact.

2. Long-term Exposure: Repeated or prolonged exposure to phenol may cause chronic phenol poisoning. The symptoms of chronic poisoning include vomiting, difficulty in swallowing, diarrhea, lack of appetite, headache, fainting, dizziness, dark urine, mental disturbances, and possibly a skin rash. Liver damage and discoloration of the skin may occur.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to phenol.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to phenol at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a history of convulsive disorders or abnormalities of the skin, respiratory tract, liver, or kidneys would be expected to be at increased risk from exposure. Examination of the liver, kidneys, and respiratory tract should be stressed. The skin should be examined for evidence of chronic disorders.

—Urinalysis: Darkening of the urine has occurred in persons exposed to phenol after accidental ingestion or skin contact. A urinalysis should be performed, including at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment. Urinary phenol is useful if good individual background levels are available.

—Liver function tests: Since liver damage has been observed in humans exposed to phenol, a profile of liver function should be performed by using a medically acceptable array of biochemical tests.

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

- **Method**

Sampling and analyses may be performed by collection of phenol in a bubbler containing sodium hydroxide, followed by treatment with sulfuric acid, and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure phenol may be used. An analytical method for phenol is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 6, 1980, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00369-6).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with solid or liquid phenol or liquids containing phenol.
- If employees' clothing has had any possibility of being contaminated with solid or liquid phenol or liquids containing phenol, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing which has had any possibility of being contaminated with solid or liquid phenol or liquids containing phenol should be placed in closed containers for storage until it can be discarded or until provision is

made for the removal of phenol from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the phenol, the person performing the operation should be informed of phenol's hazardous properties.

- Where there is any possibility of exposure of an employee's body to solid or liquid phenol or liquids containing phenol, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Non-impervious clothing which becomes contaminated with phenol should be removed immediately and not reworn until the phenol is removed from the clothing.
- Employees should be provided with and required to use dust- and splash-proof safety goggles where there is any possibility of solid or liquid phenol or liquids containing phenol contacting the eyes.
- Where there is any possibility that employees' eyes may be exposed to solid or liquid phenol or liquids containing phenol, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes contaminated with phenol should be immediately washed or showered with soap or mild detergent and water to remove any phenol.
- Any clothing which becomes wet with liquid phenol or liquids containing phenol should be removed immediately and not reworn until the phenol is removed from the clothing.
- Eating and smoking should not be permitted in areas where solid or liquid phenol or liquids containing phenol are handled, processed, or stored.
- Employees who handle solid or liquid phenol or liquids containing phenol should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to phenol may occur and control methods which may be effective in each case:

Operation	Controls
Application and curing of bonding resin in plywood manufacture; application and curing of molding resins in manufacture of molded articles, such as	Process enclosure; local exhaust ventilation; personal protective equipment

ORIGINAL
HEW
(red)

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

- If phenol is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill.

2. If in the solid form, for small quantities, sweep onto paper or other suitable material, place in an appropriate container and burn in a safe place (such as a fume hood). Large quantities may be reclaimed; however, if this is not practical, dissolve in a flammable solvent (such as alcohol) and atomize in a suitable combustion chamber.

3. If in the liquid form, for small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be collected and atomized in a suitable combustion chamber.

- Waste disposal methods:

Phenol may be disposed of:

1. If in the solid form, by making packages of phenol in paper or other flammable material and burning in a suitable combustion chamber, or by dissolving phenol in a flammable solvent (such as alcohol) and atomizing in a suitable combustion chamber.

2. If in the liquid form, by absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill, or by atomizing the liquid in a suitable combustion chamber.

REFERENCES

- American Conference of Governmental Industrial Hygienists: "Phenol," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.
- American Industrial Hygiene Association: "Phenol," *Hygienic Guide Series*, Detroit, Michigan, 1957.
- Baskin, A. D. (ed.): *Handling Guide for Potentially Hazardous Commodities*, Railway Systems and Management Association, Chicago, 1972.
- Boutwell, R. K., and Bosch, D. K.: "The Tumor-promoting Action of Phenol and Related Compounds for Mouse Skin," *Cancer Research*, 19:413-424, 1959.
- Christensen, H. E., and Luginbyhl, T. L. (eds.):

NIOSH Toxic Substances List, 1974 Edition, Publication No. 74-134, 1974.

- Community Air Quality Guides: "Phenol and Cresol," *American Industrial Hygiene Association Journal*, 30:425-428, 1969.
- Deichmann, W. B., and Witherup, S.: "Phenol Studies VI: The Acute and Comparative Toxicity of Phenol and o-, m-, and p-Cresols for Experimental Animals," *Journal of Pharmacology and Experimental Therapy*, 80, 233, 1944.
- Fairhall, L. T.: *Industrial Toxicology* (2nd ed.), Williams and Wilkins, Baltimore, 1957.
- Gleason, M. N., Gosselin, R. E., Hodge, H. C., and Smith, R. P.: *Clinical Toxicology of Commercial Products* (3rd ed.), Williams and Wilkins, Baltimore, 1969.
- Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.
- *Hygienic Information Guide No. 40 - Phenol*, Commonwealth of Pennsylvania, Department of Environmental Resources, Bureau of Occupational Health, 1968.
- Jacobs, M.: *The Analytical Chemistry of Industrial Poisons, Hazards, and Solvents*, Interscience, New York, 1956.
- Manufacturing Chemists Association, Inc.: *Chemical Safety Data Sheet SD-4, Phenol*, Washington, D.C., 1964.
- Merliss, R. R.: "Phenol Marasmus," *Journal of Occupational Medicine*, 14:55-56, 1972.
- National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare: *Criteria for a Recommended Standard . . . Occupational Exposure to Phenol*, HEW Publication No. (NIOSH) 76-196, GPO No. 017-033-00184-7, U.S. Government Printing Office, Washington, D.C., 1976.
- Ohtsuji, H., and Ikeda, M.: "Quantitative Relationship between Atmospheric Phenol Vapour and Phenol in the Urine of Workers in Bakelite Factories," *British Journal of Industrial Medicine*, 29:70-73, 1972.
- Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.
- Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.
- Spector, W. S. (Vols. I, II), Negherbon, W. O. (Vol. III), Grebe, R. M. (Vol. IV), and Dittmer, D. S. (Vol. V) (eds.): *Handbook of Toxicology*, Saunders, Philadelphia, 1956-1959.
- Summer, W.: *Odor Pollution of Air: Causes and Control*, L. Hill, London, 1975.
- Thienes, C. H., and Haley, T. J.: *Clinical Toxicology* (5th ed.), Lea and Febiger, Philadelphia, 1972.
- Union Carbide Corporation, Industrial Medicine and Toxicology Department: *Toxicology Studies - Phenol*, New York, 1966.

RESPIRATORY PROTECTION FOR NICKEL METAL AND SOLUBLE COMPOUNDS

ORIGINAL
(Red)

Condition	Minimum Respiratory Protection* Required Above 1 mg/m ³
Dust, Mist, or Fume Concentration	
10 mg/m ³ or less	Any fume respirator or high efficiency particulate respirator. Any supplied-air respirator. Any self-contained breathing apparatus.
50 mg/m ³ or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
1000 mg/m ³ or less	A powered air-purifying respirator with a high efficiency particulate filter. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
2000 mg/m ³ or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 2000 mg/m ³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for Tetrachloroethylene*

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $\text{CCl}_2 = \text{CCl}_2$
- Synonyms: Perchloroethylene; perchlorethylene; tetrachlorethylene; perk
- Appearance and odor: Colorless liquid with an odor like chloroform or ether.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for tetrachloroethylene is 100 parts of tetrachloroethylene per million parts of air (ppm) averaged over an eight-hour work shift, with a ceiling level of 200 ppm and a maximum acceptable peak of 300 ppm for 5 minutes in any three-hour period. NIOSH has recommended that the permissible exposure limit be reduced to 50 ppm (339 mg/m³) averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling level of 100 ppm (678 mg/m³) averaged over a 15-minute period. The NIOSH Criteria Document for Tetrachloroethylene should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

- **Routes of exposure**
Tetrachloroethylene can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.
- **Effects of overexposure**
1. Short-term Exposure: Tetrachloroethylene may cause headache, nausea, drowsiness, dizziness, incoordination, and unconsciousness. It may also cause irritation of

the eyes, nose, and throat and flushing of the face and neck. In addition, it might cause liver damage with such findings as yellow jaundice and dark urine. The liver damage may become evident several weeks after the exposure.

2. Long-term Exposure: Prolonged or repeated overexposure to liquid tetrachloroethylene may cause irritation of the skin. It might also cause damage to the liver and kidneys.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to tetrachloroethylene.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to tetrachloroethylene at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the liver and the cardiovascular and neurological systems should be stressed. The skin should be examined for evidence of chronic disorders.

—Liver function tests: Tetrachloroethylene may cause liver damage. A profile of liver function should be obtained by using a medically acceptable array of biochemical tests.

—Urinalysis: Since kidney damage has also been observed from exposure, a urinalysis should be obtained to include at minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

• Summary of toxicology

Tetrachloroethylene vapor is a narcotic. Rats did not survive when exposed for longer than 12-18 minutes to 12,000 ppm; when exposed repeatedly to 470 ppm they showed liver and kidney injury. Cardiac arrhythmias

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

three measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• **Method**

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure tetrachloroethylene may be used. An analytical method for tetrachloroethylene is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid tetrachloroethylene.
- Non-impervious clothing which becomes contaminated with liquid tetrachloroethylene should be removed promptly and not reworn until the tetrachloroethylene is removed from the clothing.
- Clothing wet with liquid tetrachloroethylene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of tetrachloroethylene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the tetrachloroethylene, the person performing the operation should be informed of tetrachloroethylene's hazardous properties.

- Employees should be provided with and required to use splash-proof safety goggles where liquid tetrachloroethylene may contact the eyes.

SANITATION

- Skin that becomes contaminated with liquid tetrachloroethylene should be promptly washed or showered with soap or mild detergent and water to remove any tetrachloroethylene.
- Employees who handle liquid tetrachloroethylene should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to tetrachloroethylene may occur and control methods which may be effective in each case:

Operation	Controls
Use as dry cleaning solvent; as degreasing and metal cleaning agent; in vapor degreasing of metal parts	Local exhaust ventilation; general dilution; personal protective equipment
Use as chemical intermediate in production of fluorocarbons, pesticides, and trichloroacetic acid	Process enclosure; local exhaust ventilation; general dilution ventilation
Use as scouring, sizing, desizing, solvent and greaser remover in processing and finishing of textiles	Local exhaust ventilation; general dilution; personal protective equipment
Use as general industrial solvent in rubber, textile, printing, soap, and paint remover industries	Local exhaust ventilation; general dilution; personal protective equipment
Use as extraction agent for vegetable and mineral oils and in pharmaceutical industry; as vermifuge; as laundry treatment for presoaking and as drying medium in metal and wood industries	Local exhaust ventilation; general dilution ventilation; personal protective equipment

- Spector, W. S. (Vols. I, II), Negherbon, W. O. (Vol. III), Grebe, R. M. (Vol. IV), and Dittmer, D. S. (Vol. V) (eds.): *Handbook of Toxicology*, Saunders, Philadelphia, 1956-1959.
- Stecher, P. G. (ed.): *The Merck Index* (8th ed.), Merck Co., Inc., Rahway, New Jersey, 1968.
- Stern, A. C. (ed.): *Air Pollution* (2nd ed.), Academic Press, New York, 1968.
- Stewart, R. D.: "Acute Tetrachloroethylene Intoxication," *Journal of the American Medical Association*, 208:1490-1492, May 26, 1969.
- Stewart, R. D., and Dodd, H. C.: "Absorption of Carbon Tetrachloride, Trichloroethylene, Tetrachloroethylene, Methylene Chloride, and 1,1,1-Trichloroethane through the Human Skin," *Industrial Hygiene Journal*, September - October:439, 1964.

• von Oettingen, W. F.: *The Halogenated Aliphatic Olefinic, Cyclic, Aromatic, and Aliphatic-Aromatic Hydrocarbons Including the Halogenated Insecticides, Their Toxicity and Potential Dangers*, U.S. Public Health Service Publication No. 414, U.S. Government Printing Office, Washington, D.C., 1955.

* SPECIAL NOTE

Tetrachloroethylene appears on the OSHA "Candidate List" of chemicals being considered for further scientific review regarding its carcinogenicity (*Federal Register*, Vol. 45, No. 157, pp. 5372-5379, 12 August 1980). The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 20, 1979.

RESPIRATORY PROTECTION FOR TETRACHLOROETHYLENE

Condition	Minimum Respiratory Protection* Required Above 100 ppm
Vapor Concentration	
500 ppm or less	Any chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s). A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 500 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for Toluene

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $C_6H_5CH_3$
- Synonyms: Toluol; phenylmethane; methylbenzene
- Appearance and odor: Colorless liquid with an aromatic odor, like benzene.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for toluene is 200 parts of toluene per million parts of air (ppm) averaged over an eight-hour work shift, and during any such work shift, 300 ppm toluene may not be exceeded except that a peak of 500 ppm toluene is permitted for 10 minutes during the eight-hour work shift. NIOSH has recommended that the permissible exposure limit be reduced to 100 ppm toluene averaged over an eight-hour work shift with a ceiling level of 200 ppm averaged over a ten-minute period. The NIOSH Criteria Document for Toluene should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

- **Routes of exposure**
Toluene can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may enter the body through the skin.
- **Effects of overexposure**
 1. **Short-term Exposure:** Toluene may cause irritation of the eyes, respiratory tract, and skin. It may also cause fatigue, weakness, confusion, headache, dizziness, and drowsiness. Peculiar skin sensation may be produced

such as a "pins and needles feeling" or numbness. Very high concentrations may cause unconsciousness and death. The liquid splashed in the eye may cause irritation and temporary damage. Inhalation may also cause difficulty in seeing in bright light. If liquid toluene is splashed in the eyes, it will cause temporary irritation.

2. **Long-term Exposure:** Repeated or prolonged exposure to liquid toluene may cause drying and cracking of the skin.

3. **Reporting Signs and Symptoms:** A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to toluene.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to toluene at potentially hazardous levels:

1. **Initial Medical Examination:**

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the central nervous system, liver and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

—Urinalysis: Since proper kidney function is necessary for biologic monitoring, a urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment. The urine should be analyzed for hippuric acid to obtain a background level.

2. **Periodic Medical Examination:** The aforementioned medical examinations should be repeated on an annual basis. Hippuric acid level in urine may be an indicator of the level of toluene exposure.

- **Summary of toxicology**

Toluene vapor causes narcosis. Controlled exposure of human subjects to 200 ppm for 8 hours produced mild fatigue, weakness, confusion, lacrimation, and paresthesia; at 600 ppm for 8 hours there were also euphoria, headache, dizziness, dilated pupils and nausea; at 800

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure toluene may be used. An analytical method for toluene is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

Methods for Set V" (order number PB 262 524).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid toluene.
- Any clothing which becomes wet with liquid toluene should be removed immediately and not reworn until the toluene is removed from the clothing.
- Clothing wet with toluene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of toluene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the toluene, the person performing the operation should be informed of toluene's hazardous properties.
- Employees should be provided with and required to use splash-proof safety goggles where liquid toluene may contact the eyes.
- Where there is any possibility that employees' eyes may be exposed to toluene, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes wet with liquid toluene should be promptly washed or showered with soap or mild detergent and water to remove any toluene.
- Employees who handle liquid toluene should wash their hands thoroughly with soap or mild detergent and water before eating or smoking.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to toluene may occur and control methods which may be effective in each case:

Operation	Controls
Use as a solvent in pharmaceutical, chemical, rubber, and plastics industries; as a thinner for paints, lacquer, coatings, and dyes; as a paint remover; insecticides	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment
Use as starting material and intermediate in organic chemical and chemical synthesis industries	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment
Use in manufacture of artificial leather; fabric and paper coatings; photogravure ink production; spray surface coating; as a diluent (cellulose ester lacquers)	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment
Use as constituent in formulation of automotive and aviation fuels	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If liquid toluene gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If liquid toluene gets on the skin, promptly wash the contaminated skin using soap or mild detergent and

RESPIRATORY PROTECTION FOR TOLUENE

ORIGINAL
(Red)

Condition	Minimum Respiratory Protection* Required Above 200 ppm
Vapor Concentration	
500 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s). Any supplied-air respirator. Any self-contained breathing apparatus.
1000 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s).
2000 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 2000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for Methyl Chloroform

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: CH_2Cl_2
- Synonyms: 1,1,1-trichloroethane; 1,1,1-trichloroethane, stabilized
- Appearance and odor: Colorless liquid with a mild odor, like chloroform.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for methyl chloroform is 350 parts of methyl chloroform per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 1910 milligrams of methyl chloroform per cubic meter of air (mg/m^3). NIOSH has recommended that the permissible exposure limit be changed to a ceiling of 350 ppm ($1910 \text{ mg}/\text{m}^3$) averaged over a 15-minute period. The NIOSH Criteria Document for 1,1,1-Trichloroethane should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

• Routes of exposure

Methyl chloroform can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

• Effects of overexposure

1. Short-term Exposure: Exposure to methyl chloroform vapor may cause headache, dizziness, drowsiness, unconsciousness, irregular heart beat, and death. Methyl chloroform liquid splashed in the eyes may cause irritation.

2. Long-term Exposure: Prolonged or repeated skin contact with liquid methyl chloroform may cause irritation of the skin. Reproductive abnormalities have been noted in studies of animals exposed to high concentrations of methyl chloroform.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to methyl chloroform.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to methyl chloroform at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the employee at increased risk, and to establish a baseline for future health monitoring. Examination of the skin, liver, and cardiovascular system should be stressed. The physician should be made aware of any adverse reproductive effects in workers exposed to methyl chloroform.

—Skin disease: Methyl chloroform can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Liver disease: At high concentrations, methyl chloroform causes liver changes in animals, which justifies consideration of the possible consequences before exposing persons with impaired liver function.

—Cardiovascular disease: In persons with impaired cardiovascular function, especially those with a history of cardiac arrhythmias, the inhalation of methyl chloroform might cause exacerbation of disorders of the conduction mechanism due to its sensitizing effects on the myocardium.

—Medical warning: Workers should be provided with information advising them of studies in which congenital abnormalities were found following exposure of animals to high concentrations of methyl chloroform.

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF LABOR
Occupational Safety and Health Administration

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid methyl chloroform.

- Non-impervious clothing which becomes wet with liquid methyl chloroform should be removed promptly and not reworn until the methyl chloroform is removed from the clothing.

- Employees should be provided with and required to use splash-proof safety goggles where liquid methyl chloroform may contact the eyes.

SANITATION

- Skin that becomes wet with liquid methyl chloroform should be promptly washed or showered to remove any methyl chloroform.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to methyl chloroform may occur and control methods which may be effective in each case:

Operation

Use as solvent in cold cleaning of metals, and plastics; in vapor degreasing; in ultrasonic cleaning; in dyeing and cleaning of fabrics and yarns

Use in organic synthesis in polymer manufacture; as primary and carrier solvent in spot cleaners, adhesives, shoe polishes, stain repellants, hair sprays, Mace, insecticides, resins, inks, lubricants, protective coatings, asphalt extraction, and waste water treatment; use in aerosol manufacture as pressure depressant

Use as coolant and lubricant in cutting oils on metals; use during printed circuit boards production; liquid Drano production and photographic film processing

Controls

General dilution ventilation; local exhaust ventilation; personal protective equipment

Process enclosure; local exhaust ventilation

General dilution ventilation; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Eye Exposure

If methyl chloroform gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• Skin Exposure

If methyl chloroform gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If methyl chloroform soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• Breathing

If a person breathes in large amounts of methyl chloroform, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

RESPIRATORY PROTECTION FOR METHYL CHLOROFORM

ORIGINAL
(Red)

Condition	Minimum Respiratory Protection* Required Above 350 ppm
Vapor Concentration	
500 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s). Any supplied-air respirator. Any self-contained breathing apparatus.
1000 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s). A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 1000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR TRICHLOROETHYLENE POTENTIAL HUMAN CARCINOGEN

INTRODUCTION

This guideline summarizes pertinent information about trichloroethylene for workers, employers, and occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; therefore, readers are advised to regard these recommendations as general guidelines.

SUBSTANCE IDENTIFICATION

- **Formula:** C_2HCl_3
- **Structure:** $CCl_2 = CHCl$
- **Synonyms:** Acetylene trichloride, ethylene trichloride, TCE
- **Identifiers:** CAS 79-01-6; RTECS KX455000; DOT 1710, label required: "St. Andrew's Cross (X)"
- **Appearance and odor:** Colorless liquid with a sweet odor like chloroform

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
 1. Molecular weight: 131.38
 2. Boiling point (at 760 mmHg): 87.1°C (188°F)
 3. Specific gravity (water = 1): 1.46
 4. Vapor density (air = 1 at boiling point of trichloroethylene): 4.54
 5. Melting point: -86.4°C (-123°F)
 6. Vapor pressure at 25°C (77°F): 74.3 mmHg
 7. Solubility in water, g/100 g water at 25°C (77°F): 0.00011
 8. Evaporation rate (butyl acetate = 1): 6.2
 9. Saturation concentration in air (approximate) at 25°C (77°F): 10.1% (101,000 ppm)
 10. Ionization potential: 9.47 eV
- **Reactivity**
 1. Incompatibilities: Trichloroethylene may react violently with chemically active metals such as barium, lithium, sodium, magnesium, and titanium. Aluminum may react with the free hydrogen chloride in trichloroethylene to produce aluminum

chloride, which catalyzes a violent self-accelerating polymerization reaction. Contact with strong caustics may cause the formation of dichloroacetylene, a toxic and flammable gas.

2. Hazardous decomposition products: Toxic vapors and gases (e.g., phosgene, hydrogen chloride, and carbon monoxide) may be released in a fire involving trichloroethylene.

- **Flammability**

1. Flash point: 32°C (90°F) (closed cup)
2. Autoignition temperature: 788°C (420°F)
3. Flammable limits in air, % by volume: Lower, 12.5; Upper, 90
4. Extinguishant: Alcohol foam, dry chemical, or carbon dioxide
5. Class IC Flammable Liquid (29 CFR 1910.106), Flammability Rating 1, Practically Nonflammable (NFPA)

- **Warning properties**

1. Odor threshold: 21.4 ppm
2. Eye irritation level: 400 ppm
3. Evaluation of warning properties for respirator selection: Warning properties are not considered in recommending respirators for use with carcinogens.

EXPOSURE LIMITS

The Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for trichloroethylene per million parts of air (ppm) as a time-weighted average (TWA) concentration over an 8-hour workshift; the acceptable ceiling concentration is 200 ppm; and the maximum peak concentration above the acceptable ceiling (maximum duration of 5 minutes in any 2-hour period) is 300 ppm. The National Institute for Occupational Safety and Health (NIOSH) recommends that trichloroethylene be controlled and handled as a potential human carcinogen in the workplace and that exposure be minimized to the lowest feasible limit. The American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV®) is 50 ppm (270 mg/m³) as a TWA for a normal 8-hour workday and a 40-hour workweek; the ACGIH short-term exposure limit (STEL) is 200 ppm (1,080 mg/m³) (Table 1).

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health
Division of Standards Development and Technology Transfer

may be attributed to exposure to trichloroethylene. The interviews, examinations, and appropriate medical screening and/or biologic monitoring tests should be directed at identifying an excessive decrease or adverse trend in the integrity and physiologic function of the eyes, skin, liver, kidneys, and cardiovascular, nervous, and respiratory systems as compared to the baseline status of the individual worker or to expected values for a suitable reference population.

The following tests should be used and interpreted according to standardized procedures and evaluation criteria recommended by NIOSH and ATS: standardized questionnaires and tests of lung function.

- **Medical practices recommended at the time of job transfer or termination**

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic and laboratory tests which were conducted at the time of placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared to those expected for a suitable reference population. Because occupational exposure to trichloroethylene may cause diseases of prolonged induction-latency, the need for medical surveillance may extend well beyond termination of employment.

- **Sentinel health events**

1. Acute SHE's include: Contact and/or allergic dermatitis.
2. Delayed-onset SHE's include: Toxic hepatitis.

MONITORING AND MEASUREMENT PROCEDURES

- **TWA exposure evaluation**

Measurements to determine worker exposure to trichloroethylene should be taken so that the TWA exposure is based on a single entire workshift sample or an appropriate number of consecutive samples collected during the entire workshift. Under certain conditions, it may be appropriate to collect several short-term interval samples (up to 30 minutes each) to determine the average exposure level. Air samples should be taken in the worker's breathing zone (air that most nearly represents that inhaled by the worker).

- **Method**

Sampling and analysis may be performed by collecting trichloroethylene vapors with charcoal adsorption tubes followed by desorption with carbon disulfide and analysis by gas chromatography. Detector tubes or other direct-reading devices calibrated to measure trichloroethylene may also be used if available. A detailed sampling and analytical method for trichloroethylene may be found in the *NIOSH Manual of Analytical Methods* (method number S336).

PERSONAL PROTECTIVE EQUIPMENT

Chemical protective clothing (CPC) should be selected after utilizing available performance data, consulting with the manufacturer, and then evaluating the clothing under actual use conditions.

Workers should be provided with and required to use CPC, gloves, and other appropriate protective clothing necessary to prevent skin contact with trichloroethylene.

SANITATION

Clothing which is contaminated with trichloroethylene should be removed immediately and placed in sealed containers for storage until it can be discarded or until provision is made for the removal of trichloroethylene from the clothing. If the clothing is to be laundered or cleaned, the person performing the operation should be informed of trichloroethylene's hazardous properties. Reusable clothing and equipment should be checked for residual contamination before reuse or storage.

A change room with showers, washing facilities, and lockers that permit separation of street and work clothes should be provided.

Workers should be required to shower following a workshift and prior to putting on street clothes. Clean work clothes should be provided daily.

Skin that becomes contaminated with trichloroethylene should be promptly washed with soap and water.

The storage, preparation, dispensing, or consumption of food or beverages, the storage or application of cosmetics, the storage or smoking of tobacco or other smoking materials, or the storage or use of products for chewing should be prohibited in work areas.

Workers who handle trichloroethylene should wash their faces, hands, and forearms thoroughly with soap and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

Common operations in which exposure to trichloroethylene may occur and control methods which may be effective in each case are listed in Table 2.

Table 2.—Operations and methods of control for trichloroethylene

Operations	Controls
During use as a cleaning solvent in cold cleaning and vapor degreasing operations	Process enclosure, local exhaust ventilation, personal protective equipment
During use as a scouring and cleaning agent in textile processing; during use in the extraction and purification of animal and vegetable oils in food and pharmaceutical industries; during use in chemical synthesis	Process enclosure, local exhaust ventilation
During use in the manufacture of adhesives, anesthetics and analgesics, and cleaning and polishing preparations	Process enclosure, local exhaust ventilation
During use as a fumigant and disinfectant for seeds and grains	Local exhaust ventilation, personal protective equipment

- Fukuda, K., Takemoto, K., and Tsuruta, H.: "Inhalation Carcinogenicity of Trichloroethylene in Mice and Rats," *Industrial Health*, 21:243-254, 1983.
- Goldman, R.H., and Peters, J.M.: "The Occupational and Environmental Health History," *Journal of the American Medical Association*, 246:2831-2836, 1981.
- Haglid, K.G., Briving, C., Hansson, H.A., Rosengran, L., Kjellstrand, P., Stavron, D., Swedin, U., and Wronski, A.: "Trichloroethylene: Long-Lasting Changes in the Brain after Rehabilitation," *Neurotoxicology*, 2:659-673, 1981.
- Halperin, W.E., Ratcliffe, J., Frazier, T.M., Wilson, L., Becker, S.P., and Shulte, P.A.: "Medical Screening in the Workplace: Proposed Principles," *Journal of Occupational Medicine*, 28(8): 547-552, 1986.
- Hankinson, J.L.: "Pulmonary Function Testing in the Screening of Workers: Guidelines for Instrumentation, Performance, and Interpretation," *Journal of Occupational Medicine*, 28(10):1081-1092, 1986.
- Henschler, D., Romen, W., Elsasser, H., Reichert, D., Eder, E., and Radwan, Z.: "Carcinogenicity Study of Trichloroethylene by Long Term Inhalation in Three Animal Species," *Archives fur Toxicology*, 43:237-248, 1980.
- International Agency for Research on Cancer: *IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans, Some Halogenated Hydrocarbons*, Vol. 20, Lyon, France, 1979.
- Leidel, N.A., Busch, K.A., and Lynch, J.R.: *Occupational Exposure Sampling Strategy Manual*, U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 77-173, Cincinnati, 1977.
- Levy, B.S., and Wegman, D.H. (eds.): *Occupational Health: Recognizing and Preventing Work-Related Disease*, Little, Brown and Company, Boston, 1983.
- Mark, H.F., Othmer, D.F., Overberger, C.G., Seaborg, G.T., Grayson, M., and Eckroth D. (eds.): *Kirk-Othmer Encyclopedia of Chemical Technology* (3rd ed.), John Wiley & Sons, Inc., New York, 1981.
- Myers, W., Bollinger, N., Hodous, T., Leidel N., Rabinovitz, S., and Reed, L.: *NIOSH Respirator Decision Logic*, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Division of Standards Development and Technology Transfer, Document Development Branch, Cincinnati, 1985.
- National Fire Protection Association: *National Fire Codes*® (Vol. 13), Quincy, Massachusetts, 1978.
- National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control: *Criteria for a Recommended Standard . . . Occupational Exposure to Trichloroethylene*, DHEW (NIOSH) Publication No. HSM 73-11025, 1973.
- National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control: "Current Intelligence Bulletin 2—Trichloroethylene," *Current Intelligence Bulletin Reprints—Bulletins 1 thru 18*, DHEW (NIOSH) Publication No. 78-127, 1979.
- National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control: *Special Occupation Hazard Review with Control Recommendations—Trichloroethylene*, DHEW (NIOSH) Publication No. 78-130, 1978.
- National Institute for Occupational Safety and Health, U.S. Department of Health, Education, and Welfare, Public Health Service, Center for Disease Control: "Trichloroethylene," *NIOSH Manual of Analytical Methods* (2nd ed., Vol. 3), Taylor, D.G. (ed.), DHEW (NIOSH) Publication No. 77-157-C, Cincinnati, 1977.
- National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control: *Registry of Toxic Effects of Chemical Substances* (Microfiche Edition), Sweet, D.V., and Lewis, R.J. (eds.), Cincinnati, April 1985.
- Proctor, N.H., and Hughes, J.P.: *Chemical Hazards of the Workplace*, J.B. Lippincott Company, Philadelphia, 1978.
- Rom, W.N. (ed.): *Environmental and Occupational Medicine*, Little, Brown and Company, Boston, 1983.
- Rothstein, M.A.: *Medical Screening of Workers*, Bureau of National Affairs, Washington, DC, 1984.
- Rutstein, D.D., Mullan, R.J., Frazier, T.M., Halperin, W.E., Melius, J.M., and Sestito, J.P.: "Sentinel Health Events (Occupational): A Basis for Physician Recognition and Public Health Surveillance," *American Journal of Public Health*, 73:1054-1062, 1983.
- Scientific Assembly on Environmental and Occupational Health: "Evaluation of Impairment/Disability Secondary to Respiratory Disease," *American Review of Respiratory Diseases*, 126:945-951, 1982.
- Scientific Assembly on Environmental and Occupational Health: "Surveillance for Respiratory Hazards in the Occupational Setting," *American Review of Respiratory Diseases*, 126:952-956, 1982.

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
P.O. BOX 1436, SCHENECTADY, NY 12301 USA
(518) 385-2577



No. 45

ZINC OXIDE

Date December 1978

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: ZINC OXIDE

DESCRIPTION: A fine particulate pigment, filler, or reinforcing agent; or an aerosol fume formed, for example, when zinc metal is burned.

OTHER DESIGNATIONS: ZnO, Zinc White, Chinese White, Flowers of Zinc, ASTM D79, GE Material D4C8, CAS# 001 314 132

MANUFACTURER: Material is available from several suppliers.

SECTION II. INGREDIENTS AND HAZARDS

Zinc Oxide

Typical impurities in particulate ZnO:

Lead (as PbO) <0.1% (usually <0.01%)
Sulfur <0.2%
Water soluble salts <0.9%
Moisture and volatiles <0.5%

*Current OSHA and ACGIH (1978) TLV as fume.

**ZnO dust as nuisance particulate. OSHA allows 15 mg/m³ for total dust. Particle size for "respirable dust" is about 0.1 to 5 microns for the greatest percent penetration and deposition deep in the lungs.

%

HAZARD DATA

>98

8-hr TWA 5 mg/m³ (fume)*

or
8-hr TWA 10 mg/m³ **
(total dust)
and 5 mg/m³
(respirable dust)

Rat, oral LD₅₀
630 mg/kg

SECTION III. PHYSICAL DATA

Melting point for pure ZnO, deg C --- 1975 Molecular weight ----- 81.37
Boiling point at 1 atm (sublimes below m.p.) Specific gravity, 20/4 C --- ca 5.6
Water solubility at 29 C, Wt.% ----- 0.016
(soluble in acidic media)

Appearance & Odor: White to yellow-white or gray amorphous powder; odorless.

SECTION IV. FIRE AND EXPLOSION DATA

LOWER UPPER

Flash Point and Method

Autoignition Temp.

Flammability Limits In Air

N/A

N/A

Extinguishing Media: This is a noncombustible material; use extinguishing media that is appropriate for the surrounding fire.

If practical, wet down with a water spray to reduce dusting and fume formation.

Firefighters must wear full protective clothing and use self-contained breathing apparatus when this material becomes airborne as dust or fume in a fire situation.

SECTION V. REACTIVITY DATA

This is a stable material under normal conditions of handling and use.

When heated at elevated temperatures, ZnO sublimes to produce toxic fumes. (Also note that zinc metal burns at elevated temperatures in air to produce ZnO fume.)

When hot ZnO can react explosively with magnesium; chlorinated rubber and ZnO mixtures can explode violently when heated at 215 C.

ZnO can absorb carbon dioxide from the air. It reacts and dissolves in mineral acids, dilute acetic acid, and in ammonium chloride solutions.

ORIGINAL
(Red)

B

ORIGINAL
(Red)

EXHIBIT B

MK-FERGUSON COMPANY
HAZARD COMMUNICATION PROGRAM

ORIGINAL
(Red)



HAZARD COMMUNICATION PROGRAM

PROJECT NAME:	METRO CONTAINER
PROJECT NUMBER:	3793
LOCATION:	TRAINER, PENNSYLVANIA
TELEPHONE:	
RESPONSIBLE SUPERVISOR:	ROBERT W. NOVAK

HAZARD COMMUNICATION PROGRAM

ORIGINAL
(Red)

Table of Contents

- A. COMPANY POLICY
- B. IDENTIFICATION OF HAZARDOUS SUBSTANCES
- C. CONTAINER LABELING
- D. MATERIAL SAFETY DATA SHEETS (MSDS)
- E. EMPLOYEE TRAINING AND INFORMATION
- F. NON-ROUTINE TASK TRAINING
- G. ACCESS TO INFORMATION BY OTHER EMPLOYERS

Appendices

- I. HAZARD COMMUNICATION CHECKLIST
- II. POTENTIALLY HAZARDOUS SUBSTANCES
- III. LIST OF JOBSITE HAZARDOUS SUBSTANCES
- IV. SAMPLE LETTER TO SUPPLIERS TO OBTAIN MSDS
- V. EMPLOYEE TRAINING
- VI. TRAINING CERTIFICATE
- VII. REFERENCES AND RESOURCES

HAZARD COMMUNICATION PROGRAM

ORIGINAL
(Red)

A. COMPANY POLICY

A-1 To protect the health and safety of our employees, MK-Ferguson Company has developed this Hazard Communication program.

1. As a company we intend to provide information about chemical hazards and other hazardous substances, and the control of hazards via our comprehensive Hazard Communication Program which includes container labeling, Material Safety Data Sheets (MSDS) and training.
2. This written Hazard Communication Program applies to all operations which MAY expose employees to hazardous substances as a result of normal work conditions or as the result of a reasonably foreseeable emergency.
3. This written Hazard Communication Program is available, upon request, to employees, their designated representatives and to appropriate representatives of state and/or federal safety and health agencies.

A-2 Scope

This program is part of the Company's comprehensive Safety and Health Program and shall be applied in conjunction with that overall program.

A-3 Responsibilities

1. The Project Manager is responsible for implementing and ensuring compliance with this written hazard communication program. The Hazard Communication checklist found in Appendix I is provided to assist the Project Manager in carrying out this responsibility.
2. The Safety Supervisor or designated Safety Representative is responsible for coordinating and administering the program, in developing and assisting in the presentation of training materials and in providing technical assistance to project supervision.
3. Each project supervisor shall become familiar with the hazard communication procedures and shall supervise the application of these procedures to tasks for which they are responsible.

B. IDENTIFICATION OF HAZARDOUS SUBSTANCES

B-1 "Hazardous Substances" are materials or mixtures which are physical hazards or are included on state or federal lists of hazardous substances (see Appendix II).

B-2 "Exposure" is any situation arising from work conditions where an employee MAY ingest, inhale, absorb or otherwise come in contact with a hazardous substance.

B-3 A master list and the MSDS's of all of the hazardous substances to which employees may be exposed on this jobsite shall be maintained in the project office (see Appendix III).

C. CONTAINER LABELING

C-1 When hazardous substances are received, the Safety Supervisor or Safety Representative shall examine the containers to determine if the labels provide the following information:

1. The identity of the hazardous substances they contain; and,
2. Appropriate warnings of the physical and health hazards associated with those substances.
3. The name and address of the chemical manufacturer or distributor.

C-2 When hazardous substances are transferred into portable containers, the responsible Project Supervisor shall ensure that the portable containers are labeled with an extra copy, of the manufacturer's label or with a printed label which includes the information in 1, 2 and 3 above.

C-3 Each Project Supervisor shall ensure that the labels on containers of hazardous substances are not removed or defaced, unless the containers are immediately relabeled with the information in 1, 2 and 3 above.

C-4 Containers without complete labels or with defaced labels will not be used on the job.

C-5 The project Safety Supervisor or Safety Representative shall review the jobsite labeling procedure at least quarterly and update as required.

D. MATERIAL SAFETY DATA SHEETS (MSDS)

D-1 Material Safety Data Sheets (MSDS's) are documents which supply information about a particular hazardous substance or mixture. Manufacturers are required to provide MSDS's when the hazardous substances are sold to distributors or purchasers.

D-2 The Safety Supervisor or Safety Representative, with the assistance of the purchasing department, will be responsible for obtaining and maintaining the master sets of MSDS's and other information on all hazardous substances used (see sample letter in Appendix IV).

D-3 MSDS's will be reviewed for completeness by the Safety Supervisor or Safety Representative. If an MSDS is missing or obviously incomplete, a new MSDS will be requested from the manufacturer. ORIGINAL (Red)

D-4 MSDS's are available to all employees in their work area for review during each work shift. If MSDS's are not available or new hazardous substance(s) in use do not have MSDS's, please contact the Safety Supervisor or Safety Representative immediately.

D-5 Project Supervisors shall be alert to other employers (such as subcontractors) whose work on the jobsite may expose employees to additional hazardous substances. When it appears such exposure will occur, MSDS's for the substances must be obtained.

D-6 When doing renovation or remodeling work, the Project Supervisor shall be alert to the dangers which might exist for our employees who work under or near unlabeled pipes which contain hazardous substances, and shall take proper precautions.

E. EMPLOYEE TRAINING AND INFORMATION

E-1 Initial Orientation

Prior to starting work, each new employee must attend a health and safety orientation which includes the items listed in Appendix V - Hazard Communication Training Program.

E-2 Training shall be provided before employees are assigned duties which may cause exposure to hazardous substances. Training shall also be given when new hazardous substances are introduced into the work area or when an MSDS is changed. In general, this training shall include:

1. Information on which hazardous substances are in the work area.
2. How to read and interpret information on MSDS's and labels.
3. Any physical or health hazards associated with the use of a hazardous substance or mixture being used in the work area.
4. Proper precautions for handling, including specific procedures the company has implemented to protect workers from exposure such as personal protective equipment and work practices.
5. Proper procedures for reporting of releases or threatened releases of hazardous substances.
6. Emergency procedures for spills, fires, disposal and first aid.
7. The methods and observations that can be used to detect the presence of a hazardous substance in the work place (odor, visual appearance or monitoring).
8. The right of employees, their physicians or their collective bargaining agents to receive information on hazardous substances to which they may be exposed.

9. The right against discharge or discrimination due to an employee's exercise of the rights afforded by law.
10. The details of this written Hazard Communication Program; the availability and location of this written Hazard Communication Program and of MSDS's or other information.

E-3 Document the training on the Training Certificate (Appendix VI) or equivalent.

E-4 Additional training shall be provided as needed during the weekly safety and health training ("toolbox") meetings in order to emphasize the safe handling, use and storage of onsite hazardous substances.

F. NON-ROUTINE TASK TRAINING

F-1 When employees are assigned to a non-routine task that may expose them to a hazardous substance for which they have not been trained, they shall be trained in the manner required by Section E.

F-2 Some examples of non-routine tasks are:

- Confined space entry.
- Tank cleaning.
- Painting reactor vessels.
- Repair of pipes containing hazardous substances.

Prior to starting work on such projects, each affected employee will be given information about the hazardous chemicals he or she may encounter during such activity. This information will include specific chemical hazards, protective and safety measures the employee can use and steps the jobsite is using to reduce the hazards, including ventilation, respirators, presence of another employee and emergency procedures.

G. ACCESS TO INFORMATION BY OTHER EMPLOYERS

G-1 It is the responsibility of the Safety Supervisor or Safety Representative to provide contractors and subcontractors with information about hazardous chemicals their employees may be exposed to on a jobsite and suggested precautions for the contractor's employees.

G-2 Contractors and subcontractors will be contacted before work is started to gather and distribute information concerning any chemical hazard that they may bring or be exposed to on our workplace.

H. ADDITIONAL INFORMATION

H-1 See Appendix VII for additional references and resources.

MK-FERGUSON COMPANY
HAZARD COMMUNICATION CHECKLIST

ORIGINAL
(Red)

1. Have we prepared a list of all the hazardous chemicals in our workplace?
2. Are we prepared to update our hazardous chemical list?
3. Have we obtained or developed a material safety data sheet for each hazardous chemical we use?
4. Have we developed a system to ensure that all incoming hazardous chemicals are checked for proper labels and data sheets?
5. Do we have procedures to ensure proper labeling or warning signs for containers that hold hazardous chemicals?
6. Are our employees aware of the specific information and training requirements of the Hazard Communication Standard?
7. Are our employees familiar with the different types of chemicals and the hazards associated with them?
8. Have our employees been informed of the hazards associated with performing non-routine tasks?
9. Do our employees understand how to detect the presence or release of hazardous chemicals in the workplace?
10. Are employees trained about proper work practices and personal protective equipment in relation to the hazardous chemicals in their work area?
11. Does our training program provide information on appropriate first aid, emergency procedures and the likely symptoms of overexposure?
12. Does our training program include an explanation of labels and warnings that are used in each work area?
13. Does the training describe where to obtain data sheets and how employees may use them?
14. Have we worked out a system to ensure that new employees are trained before beginning work?
15. Have we developed a system to identify new hazardous chemicals before they are introduced into a work area?
16. Do we have a system for informing employees when we learn of new hazards associated with a chemical we use?
17. Have the employees been advised of the enforcement procedures for failure to follow established procedures?

MK-FERGUSON COMPANYORIGINAL
(Red)POTENTIALLY HAZARDOUS SUBSTANCESWHICH MAY BE FOUND ON CONSTRUCTION PROJECTS

Acetone
Acetylene gas
Adhesives
Aluminum etching agent
Ammonia
Anti-freeze
Arsenic compounds
Asbestos
Asphalt (Petroleum) fumes
Battery Fluids
Benzene (and derivatives)
Bleaching agents
Carbon black
Carbon monoxide (in cylinders)
Caulking, sealant agents
Caustic soda (sodium hydroxide)
Chromate salts
Chromium
Cleaners
Cleaning agents
Coal tar pitch
Coal tar epoxy
Coatings
Cobalt
Concrete curing compounds
Creosol
Cutting oil (oil mist)
De-emulsifier for oil
Diesel gas, diesel oil
Drywall
Dusts (brick, cement block)
Enamel
Etching agents
Ethyl alcohol
Fiberglass, mineral wool
Foam insulation
Freon 20, R20 (and others)
Gasoline (petrol, ethyl)
Glues
Graphite
Greases
Helium (in cylinders)
Hydraulic brake fluid
Hydrochloric acid
Hydrogen (in cylinders)
Inks
Insulations
Iron
Kerosene
Lead

Lime (calcium oxide)
Limestone
Lubricating oils
Lye (sodium hydroxide, potassium hydroxide)
Magnesium
Metals (aluminum, nickel, copper, zinc, cadmium, iron, etc.)
Methanol (methyl alcohol)
Methyl ethyl ketone (2-butanone)
Motor oil additives
Muriatic acid (hydrochloric acid)
Naptha (coal tar)
Nitroglycerin
Oxalic acid
Ozone
Paint remover
Paint stripper
Paints/lacquers
Particle board
Pentachlorophenol
Pesticides
Photographic developers and fixers
Photogravure ink (copy machine)
Plastics
Polishes for metal floors
Propanol
Putty
Resins, epoxy/synthetics
Sealers
Shellac
Solder, flux (zinc chloride, fluorides, etc.)
Solder, soft (lead, tin)
Solvents
Sulfuric acid
Thinner, paint/lacquer
Tin
Transite
Turpentine, gum spirit, oil of turpentine
Varnishes
Waterproofing agents
Waxes
Welding Rods
Wood alcohol (methanol)
Wood preservative
Xylene
Zinc

APPENDIX III

MK-FERGUSON COMPANY

ORIGINAL
(Red)

LIST OF JOBSITE HAZARDOUS SUBSTANCES

On the following page(s) is a current list of the specific hazardous substances known to be present at this jobsite.

This list uses the chemical name referenced on the MSDS. Specific information on each substance may be found on the MSDS's located in the project office.

ENGINEERS
AND
CONSTRUCTORS

(PROJECT LETTERHEAD)

ENGINEERS

ORIGINAL
(Red)



MK-FERGUSON COMPANY
A MORRISON KNUDSEN COMPANY

CORPORATE OFFICE
ONE ERIEVIEW PLAZA
CLEVELAND, OHIO 44114
PHONE: (216) 523-5600/TELEX: 985542

DATE

Manufacturer/Distributor
Address
City, State Zip Code

RE: Material Safety Data Sheet

Dear Sir:

Please send us a Material Safety Data Sheet (MSDS) for the product(s) listed below:

1. _____
2. _____
3. _____

This information is for our hazard communication program as required by state and/or federal health and safety regulations.

Thank you for your assistance.

Sincerely,

NAME

APPENDIX VMK-FERGUSON COMPANYHAZARD COMMUNICATION EMPLOYEE TRAINING PROGRAM

Our employee training program has been developed on the basis of groups (types) of hazardous substance(s) used and the common hazards associated with them.

For specific hazard information on each brand of material the MATERIAL SAFETY DATA SHEETS (MSDS) must be reviewed.

OVERVIEW OF THE HAZARD COMMUNICATION REGULATION

The Hazard Communication Regulation is intended to ensure that both employers and employees are aware of the dangers associated with hazardous substances in their workplaces. The following information is a review of the specific requirements of a hazard communication program, including container labeling, MSDS and training.

WRITTEN HAZARD COMMUNICATION PROGRAM

We have a written program that outlines how we will provide information and control your exposure to hazardous substances. This plan is available for your review during our training and at the project office for review during your workshift.

HAZARDOUS SUBSTANCES USED IN OUR WORKPLACE

On this job, we use a variety of products. Many of these products contain one or more hazardous substances. Let's review the HAZARDOUS SUBSTANCE INVENTORY LIST in your work area.

READING LABELS AND MSDS

LABELS: A product label on both the original and secondary containers should be reviewed prior to working with the material. Each label will have two important pieces of information you should be familiar with:

1. The identity of the Hazardous Substance.
2. Hazard Warnings.

The label on the original container will also state the name and address of the manufacturer.

The label should act as a visual reminder of the information we have presented in this training session and of the information found in more detail on the MSDS.

It is essential for your safety that you read the Hazard Warning and only use the Hazardous Substance(s) within the guidelines prescribed on the

label. Questions concerning the label should be directed to your supervisor/foreman.

ORIGINAL
(Red)

MATERIAL SAFETY DATA SHEETS (MSDS): The MSDS is the primary means we will use to convey the necessary information about the hazards of the substances we use. The manufacturers and importers are responsible for providing us with the MSDS. The manufacturer must provide us with adequate information to use the substance safely.

PHYSICAL AND HEALTH HAZARDS OF THE HAZARDOUS SUBSTANCE(S) USED

Employees are to be trained specifically about the hazards of the substances in their work areas. This may be done by specific Hazardous Substance(s) or by categories of hazards, but in any case, the employee is to be aware that information is available on the specific hazards of individual Hazardous Substances through MSDS's.

Employees may be trained using the common type or generic chemical group or by reviewing the specific MSDS as long as the training includes the following information:

1. Measures to protect employee from the hazards (i.e., work practices, engineering controls and the use of personal protective equipment).
2. The physical and health hazards of the Hazardous Substance(s).
3. Detection of release of the substance; emergency and first aid procedures.

EXAMPLE OF GENERAL HAZARDOUS SUBSTANCE GROUP TYPE TRAINING

PRODUCT/CHEMICAL GROUP: HYDROCARBON SOLVENTS.

HEALTH EFFECTS - EFFECTS OF OVEREXPOSURE: High concentrations of solvent vapors are irritating to the eyes, nose, throat and lungs, may cause headaches and dizziness and sleepiness. Even higher levels may cause unconsciousness and may have other brain and central nervous system effects.

Prolonged or repeated liquid contact with the skin may cause defatting of the skin, leading to dryness, possible irritation and dermatitis (reddening and inflamed skin). Some solvents are absorbed right through the skin and the health effects are just as if the solvent vapor was inhaled.

Each organic solvent's possible long term health effects will vary; however, prolonged solvent exposures are related to possible liver, kidney and central nervous system and brain damage (NOTE: THE VARIETY OF SOLVENT TYPES SHOULD BE REVIEWED).

PHYSICAL HAZARDS: Hydrocarbon solvents are flammable and combustible and represent fire and explosion hazards if the materials are not handled correctly. Hydrocarbon solvents are generally stable and will not react violently with water. Review the MSDS section on Fire and Explosion Hazard information. Most solvents will vaporize rapidly and become airborne.

DETECTION OF RELEASE: Odor - Solvent vapor may produce an odor or cause your nose or eyes to be irritated, but do not depend on odor to warn you. Odor thresholds (lowest level that can be detected) for most solvents vary widely from person to person. Also, some solvents produce "olfactory fatigue" - the rapid loss of ability to smell the odor. However, odor can warn you of exposure to some solvents (confirm this with industrial hygiene monitoring).

Appearance - Most solvent vapors are invisible so do not rely on appearance to warn you for exposure.

Instrumentation - A variety of industrial hygiene instruments can be used to measure employee exposure. This equipment should be operated only by qualified personnel.

EMERGENCY RESPONSE - FOR FLAMMABLE SOLVENTS: If the material is spilled or leaks, shut-off and eliminate all sources of ignition. Recover the free product by adding sand, earth or other absorbents to the spill. Minimize breathing vapors and skin contact. Ventilate the area with local exhaust or by opening windows and doors. Follow the established hazardous waste disposal procedures.

EXPOSURE CONTROL: Protective Equipment, Engineering Controls and Proper Work Practices:

- ° **Protective Equipment** - Use chemical-resistant gloves, aprons or clothing if prolonged or repeated skin contact may occur. Use splash goggles and face shield when eye or face contact may occur. Use approved respiratory protective equipment as established by our Safety Program (NOTE: if needed, a review of the respiratory protective program may be appropriate).
- ° **Engineering Controls/Work Practices** - Ventilation is to be used when it is necessary to prevent build-up of vapors from both a health or fire and explosion level. Keep containers closed when not in use. Do not handle or store near heat or sources of ignition or strong oxidants. No smoking, burning or welding is permitted in the vicinity of the flammable vapors. Use the bonding and/or grounding system when transferring materials. Most solvents will vaporize rapidly and become airborne.

APPROPRIATE EMERGENCY AND FIRST AID PROCEDURES

Eye contact - If splashed into the eyes, flush with water for 15 minutes or until irritation subsides. If irritation continues, call a physician.

Skin contact - In case of skin contact, remove any contaminated clothing and wash skin thoroughly with water and soap.

Inhalation - If overcome by vapors, remove from exposure and call a physician immediately. If breathing is irregular or has stopped, start resuscitation.

Ingestion - If ingested, DO NOT induce vomiting, call emergency medical aid immediately.

APPENDIX VI

MK-FERGUSON COMPANY

ORIGINAL
(Red)

HAZARD COMMUNICATION TRAINING CERTIFICATES

I have received hazard communication training as described in the MK-Ferguson Hazard Communication Program.

Employee Name

Employee Signature

Social Security Number

Date of Training

I hereby certify that the above named employee has been provided with hazard communication training.

Supervisor/Instructor's Name

Supervisor/Instructor's Signature

APPENDIX VII

MK-FERGUSON COMPANY

ORIGINAL
(Red)

REFERENCES AND RESOURCES

MK-Ferguson Company
Safety Department
(216) 523-5508

State Agency Contacts:

Federal Agency Contacts:

Other Resources:

ORIGINAL
(Red)

C

ORIGINAL
(Red)

EXHIBIT C

MK-FERGUSON COMPANY
RESPIRATORY PROTECTION PROGRAM

Rev: 0
Date: 10/88TABLE OF CONTENTS

<u>Section</u>	<u>Content</u>	<u>Page</u>
2.1	Scope and Intent	2-1
2.2	References	2-1
2.3	Statement of Responsibilities	2-2
2.3.1	Project Managers, Construction Managers and Project Superintendents	2-2
2.3.2	Project Safety Supervisor/Industrial Hygenist	2-2
2.3.3	Employees and Subcontractors	2-3
2.4	Medical Requirements	2-4
2.4.1	General	2-4
2.4.2	Selection of a Physician	2-4
2.4.3	Examination Frequency	2-4
2.4.4	Abnormal Results	2-5
2.4.5	Work Release	2-5
2.5	Respirator Training	2-5
2.5.1	Scope	2-6
2.5.2	Fit Testing	2-7
2.5.3	Respirator Qualification Card	2-7
2.6	Respirator Selection	2-7
2.6.1	Atmosphere Suppling Respirators	2-8
2.6.2	Air Purifying Respirators	2-8
2.6.3	General Practice	2-10
2.7	Ambient Air Monitoring	2-11
2.8	Breathing Air Systems	2-11
2.8.1	Supply Cylinders	2-11
2.8.2	Compressors	
2.9	Cleaning and Disinfection	2-12
2.10	Inspections	2-12
2.10.1	Air Purifying Respirators	2-12
2.10.2	Supplied Air Systems	2-13
2.11	Respirator Storage and Maintenance	2-14
2.12	Record Retention	2-14
2.13	Program Evaluation	2-15

<u>Section</u>	<u>Content</u>
Appendix A	Explanation of Acronyms
Appendix B	Respirator Selection Chart for Routine Use
Appendix C	Employee Record of Respirator Training and Fit Test
Appendix D	Respirator Training Attendance Record
Appendix E	Common Contaminants not Compatible with Air Purifying Respirators
Appendix F	Respirator Qualification Card

MK-FERGUSON CORPORATE RESPIRATORY PROTECTION PROGRAM STATEMENT OF POLICY

It is the policy of MK-Ferguson Company to provide a healthful and safe working environment for all of its employees. Feasible engineering and administrative controls shall be instituted as far as reasonably possible to minimize actual or potential airborne exposure to harmful agents. Where it is not feasible to implement such controls, or where they are found to be inadequate, the use of respiratory protective devices may be necessary. The use of such devices are subject to the directives of this respiratory protection program. In achieving this objective, it is the intention of MK-Ferguson Company to provide respiratory protection which is both appropriate for the hazardous materials involved and compatible with the nature and extent of project requirements and conditions.

K.M. Price
Chairman and Chief Executive Officer
MK-Ferguson Company

SECTION XIX

2.0 MK-Ferguson Corporate Respiratory Protection Program2.1 SCOPE AND INTENT

This respiratory protection program describes the minimum requirements and supporting rationale associated with the selection and use of respiratory protection issued to all MK-Ferguson (MK-F) employees and authorized subcontract personnel engaged in activities requiring such protection. As such, this respiratory protection program has been designed to meet the Company's legal obligations previously established by the Occupation Safety and Health Act of 1970 as well as perceived areas of long and short term risk associated with respirator usage in potentially hazardous environments. It must be emphasized that this policy represents the minimum requirement established by MK-Ferguson Company and may not be sufficient to address the needs of projects involving hazardous wastes and/or materials where the potential for exposure is unknown.

This program supersedes any and all existing policies or directives and becomes effective immediately. Questions regarding its content or implementation are to be directed to the MK-F Safety Department.

2.2 REFERENCES

29 CFR 1910.134; General Industry Standards, Occupational Safety and Health Administration, 1987

29 CFR 1926.103; Safety and Health Regulations for Construction, Occupational Safety and Health Administration, 1986

American National Standards Institute (ANSI) Z88.6-1984
Physical Qualifications for Respirator Use

American National Standards Institute (ANSI) Z88.2-1980
Practices for Respiratory Protection

Compressed Gas Association Commodity Specification G-7.1-1973

NIOSH Guide to Industrial Respiratory Protection, Department of Health and Human Services, Publication Number 87-116

2.3 STATEMENT OF RESPONSIBILITIES

2.3.1 Project Managers, Construction Managers and Project Superintendents

Project management is ultimately responsible for ensuring the development and effective administration of this respiratory

protection program. The specific elements of the program to which project management are to be held accountable include the following:

- o Providing only NIOSH/MSHA approved respirators whenever such equipment is determined necessary to protect the health of an employee.
- o Ensuring that all respiratory protection provided is maintained and cared for in a manner consistent with the requirements of this program.
- o Issuing respiratory protective equipment only to those persons who have received the required training.
- o Issuing respiratory protective equipment only to those persons who are medically qualified to wear such protection.
- o Assisting in routine audits of the work place necessary to evaluate the effectiveness of the program.
- o Ensuring the prompt correction of any deficiencies noted as a result of program audits and personal observation.

2.3.2 Project Safety Supervisor, Industrial Hygienist, Safety Representative

The project safety supervisor/representative is responsible for oversight of the technical aspects of this respiratory protection program. If there is no safety supervisor assigned, technical support in this area will be provided to project management either by the project's regional industrial hygiene resource or by the Manager of Environmental Services. The specific technical elements to which these individuals will be held accountable include the following:

- o Conducting a thorough process evaluation to ensure that other positive means of control i.e., engineering and/or administrative controls have been considered and that their use has been determined to be neither feasible or practical.
- o Identifying those workers in need of respiratory protection.
- o Conducting any required personal sampling and/or monitoring necessary to ensure the adequacy of the respiratory protection issued.
- o Ensuring that those workers who are required to wear respirators have undergone the necessary medical evaluations to determine their fitness for respirator use.
- o Ensuring workers who are required to wear respirators have received training and instruction regarding the need for respirators, their proper use, inspection, maintenance, fit testing and limitations.

- o Issuing and maintaining respirator qualification cards.
- o Ensuring that the confidentiality of medical records resulting from this program is preserved in accordance with applicable regulations and company policy.
- o Ensuring that annual updates of training and medical evaluations are performed on a timely basis.
- o Approving of and/or selecting the appropriate respiratory protection prior to project start up.
- o Ensuring that respirators and associated supplies including prescription inserts (corrective lenses) are available in adequate quantity and in good order.
- o Ensuring the performance and documentation of all required respirator inspections.
- o Maintaining all the necessary training records.
- o Conducting and documenting periodic program audits to evaluate the effectiveness of this program.

2.3.3 Employee and Subcontractor Responsibilities

MK-Ferguson employees and authorized subcontractors are responsible for using all respiratory protection so provided in accordance with the instructions and training received. Other responsibilities include the following:

- o Wearing respiratory protection where it has been determined necessary and for the duration it is required.
- o Promptly reporting any malfunction or respirator defect to your immediate supervisor.
- o Keeping your respirator qualification card with you at all times during working hours.
- o Keeping your respirator clean and in proper working order.
- o Immediately notifying your supervisor at the first sign of contaminant breakthrough or increased resistance in breathing.

The requirements for projects which require subcontractors to provide their own respiratory protection are to include the following:

- o The submittal of evidence supporting current medical certification to the MK-F safety representative prior to respirator use.

- o Submittal of evidence of respirator training and qualitative fit testing.

2.4 MEDICAL REQUIREMENTS

2.4.1 General

Each worker to whom respiratory protection is issued must undergo a baseline medical evaluation which is intended to provide evidence of any physical and/or physiologic impairment which would prohibit his/her use of such a device. This evaluation must be conducted prior to issuance of any respiratory protection with the exception of disposable, nuisance particulate dust masks. The scope of the evaluation will be defined by the examining physician subsequent to a thorough review of the worker's medical history.

2.4.2 Selection of a Physician

All medical evaluations will, preferably, be conducted by physicians certified by the American Academy of Occupational Medicine. It is recognized, however, that due to the remote location of certain project operations finding board certified occupational physicians may be difficult. In these instances, a physician experienced in industrial practice may also be selected.

The MK-F Safety Department maintains a roster of all board certified, occupational physicians licensed to practice in the United States. Contact MK-F Environmental Services for assistance relative to their location.

2.4.3 Examination Frequency

Respirator certification will be valid for a maximum of one year from the date of the initial or previous annual evaluation. Shorter periods of certification may be issued at the discretion of the examining physician. The annual reevaluation will involve, at the minimum, the assessment of any significant medical events which may compromise the employee's ability to wear a respirator.

2.4.4 Abnormal Results

Employees and/or subcontractors showing evidence of impaired pulmonary or cardiac functions sufficient to prohibit respirator certification will not be issued respiratory protective devices or permitted to enter contaminated areas where respirator use is required.

2.4.5 Work Release

Respiratory protection, with the exception of disposable, nuisance particulate dust masks, is not to be issued to any individual unless the Respirator Certification Record (Appendix C, or equivalent) has been completed and signed. This record is designed to provide verification that the worker is medically certified to wear the respirator, ensures the completion of any required training and serves to document the performance of a qualitative fit test, as required.

2.5 RESPIRATOR TRAINING

All workers having been medically certified to wear respiratory protection must attend a comprehensive training program prior to the first use of these devices. This training program is to be provided by the project safety representative or other competent person so designated by this individual.

The content of the training program provided must address, at the minimum, the following use related elements:

- o Reasons why respiratory protection is required
- o Explanation of why more positive control i.e. local exhaust ventilation or administrative controls are not considered feasible
- o Respirator description and mechanics of airflow
- o Limitations, advantages and disadvantages associated with the respirator
- o Process of respirator selection i.e., air purifying vs air supplying (Appendix B)
- o If air purifying respirators are to be used, the process of cartridge selection and cartridge limitations
- o Protection factors
- o Donning and doffing procedures
- o Qualitative (irritant smoke) fit testing procedures
- o Cleaning, maintenance and storage requirements
- o Factors affecting proper respirator/face seal
- o Disassembly and reassembly of respirators emphasizing each component, its function and relation to the overall operation of the respirator.

The program is to consist of both formal discussion and hands-on training. Each prospective user should be allowed to don, doff and wear the respirator until the instructor is satisfied that the individual has developed confidence and familiarity regarding its use. Verification by the employee/subcontractor indicating that he or she has been trained in accordance with this policy must then be completed and retained by the project (Appendix C) with a duplicate copy sent to Corporate Headquarters for long term records retention. Refresher training is to be conducted annually.

2.5.2 Fit Testing

Qualitative fit testing of all negative pressure respirators will be conducted for each individual issued such protection. The fit test may be administered at the time of training to allow time for modifications should the worker fail. The fabrication of a simple fit test chamber, making use of a freely suspended plastic bag may be a desirable means of inhibiting the migration of the test aerosol. The test aerosol is then to be introduced by directing it at the face/respirator sealing areas. Stannic chloride (irritant smoke) due to its involuntary effect on the upper respiratory tract, is to be used as the challenge atmosphere.

Fit testing will be administered by the project safety representative or his/her designee. As indicated above, qualitative fit testing is designed to test the relative fit of a respirator against a known and easily detectable challenge atmosphere. As such, it is important that the prospective wearer achieve the best fit possible prior to entering the test chamber. Each respirator should be thoroughly inspected by the user and must be equipped with acid gas/high efficiency particulate cartridges as protection against the irritant smoke. The respirator fit should be snug but not overly tight. The relative indication of fit achieved should be evaluated by positive and negative pressure fit testing. Once a satisfactory face seal has been obtained, the individual is to enter the test chamber. If 1/2 facepiece respirators are used, the subject must be instructed to close his/her eyes while the test aerosol is being administered.

Subsequent to introducing the challenge atmosphere, the administering party will request that the individual rotate his/her head within the full range of motion in an attempt to force a leak. Exaggerated facial expressions, normal and deep breathing and passage recital will also assist in simulating actual field use. The respirator face seal is to be challenged directly by aiming the test aerosol at all sealing surfaces. When the test administrator is convinced that a satisfactory fit has been obtained, the respirator is to be removed and the user given a test smell of the aerosol to ensure a response. At that point the respirator may be assigned and the fit test log completed (Appendix A).

Qualitative fit testing will be repeated by the project safety representative or other designated individual at least annually and/or immediately following:

- o Weight loss of 20%, or more
- o Facial scarring
- o Denture or orthodontic work

A fit test failure, indicated by the wearer's ability to detect the challenge atmosphere, will require they leave the test area to readjust their respirator or choose a different style offering comparable protection under conditions similar to those indicated above. Under no circumstances will individuals who have failed a qualitative fit test be permitted to enter areas where respiratory protection is required.

2.5.3 Respirator Qualification Card

All employees who have been medically certified, trained and successfully fit tested will be issued a respirator qualification card to facilitate verification, if requested. The card will indicate the employee's name, department number, if appropriate, date of issue, type, size and model number(s) of the respirator(s) provided and a sign-off area for the safety representative who provided the card. The cards will be valid for a maximum of 1 year and reissued subsequent to each successful reevaluation.

2.6 RESPIRATOR SELECTION

Before work activities commence on any project where it is perceived that there will be a need for respiratory protection, all available data i.e., Material Safety Data Sheets, process documents, inventory records, etc., will be consulted as to the types and quantities of materials to which the potential for respiratory exposure exists. In all cases, respirator selection will be based on prior knowledge of the physical/chemical characteristics of the compounds used and how they relate to the performance specifications of the respirator chosen. The respirator selection chart (Appendix B) is to be consulted for all initial selections.

2.6.1 Air Purifying Respirators (APR's)

Air purifying respirators are those which purify the ambient air via filtration, adsorption or some other mechanism but are not designed to provide supplemental oxygen. This category includes all cartridge respirators, gas masks, powered air purifying respirators (PAPR's) and disposable, nuisance particulate masks. As such, APR's may be worn only under the following circumstances.

- o They bear a NIOSH/MSHA approval
- o The environment contains adequate oxygen i.e., greater than 19.5% O₂, by volume
- o The contaminants which could be encountered have adequate warning properties i.e., smell, taste and/or irritation (Refer to Appendix E for compounds not compatible with APR usage).
- o The respirator cartridges will be selected on the basis of the chemical contaminants to be encountered.
- o The concentration of the contaminants in question are within the service limit of the cartridge as indicated by the manufacturer.

2.6.1.1 Disposable Respirators

Disposable respirators will be approved in this context for use against nuisance particulates, only. Nuisance particulates are characterized as biologically inert, non-toxic compounds whose presence is considered undesirable. Examples include most wood dusts, gypsum, portland cement, emery, calcium carbonate, alumina, etc. If there is any question, the determination regarding the use of these respirators will be made by the project safety representative in consultation with the regional industrial hygiene resource or the Manager of Environmental Services, as required.

2.6.1.2 Powered Air Purifying Respirators (PAPR's)

This program limits the use of PAPR's to asbestos and certain types of hazardous waste related work where there is the potential for heat stress and the use of air purifying respirators is acceptable. PAPR's are not to be used as substitutes for supplied air respirators. Consultation regarding their use must be obtained from either the regional industrial hygiene resource or the Manager of Environmental Services.

2.6.2 Atmosphere Supplying Respirators

Atmosphere supplying respirators are those which provide a clean, breathable atmosphere which is independent of the surrounding environment. With some restriction, they are designed for use in environments which have been poorly or previously uncharacterized, or where concentrations of the contaminants are too high for air purifying respirators. This classification of respirator includes the following:

- o Positive pressure, demand, self contained breathing apparatus (SCBA)
- o Type C Supplied Air Respirators (Type C SAR)
- o Emergency Escape Units
- o Supplied air hoods

2.6.2.1 Positive pressure, demand, airline and self contained breathing apparatus

SCBAs and supplied air (airline) respirators with a minimum of 5 minutes of emergency supply may be used only under the following circumstances:

- o The unit bears NIOSH/MSHA approval
- o Work is to be conducted where the contaminants or their generation potential is unknown, with prior knowledge, however, that immediately dangerous to life and health (IDLH) atmospheres will not be encountered.
- o Emergency entry (rescue) into an unventilated or confined area where the exposure conditions have not been previously characterized. This individual must be accompanied by another, adequately protected worker. Permissible practice would also allow the wearing of a harness and safety line if tended by a person in a safe area having no other duties, assuming that the proper rescue equipment is available.
- o If the suspected contaminants have poor warning properties or are in concentrations which exceed the certification limits of the cartridge thereby precluding the use of air purifying respirators.

No worker is to enter an atmosphere considered oxygen deficient or otherwise immediately dangerous to life and health in anything other than an emergency situation (rescue). Appropriate engineering controls e.g., induced ventilation or other methods must be employed as a means of mitigating such conditions prior to worker entry.

2.6.2.2 Airline Respirators

Airline respirators offer the benefits of greater air supply and reduced weight when compared to self contained breathing apparatus. Fittings for airline respirators are either manufactured by Hansen or Schrader to prevent the inadvertent connection of the airline to gasses other than breathing air. NIOSH/MSHA certification limits the length of the airline to 300 feet. When airline use is necessary, a stand by person or a low pressure alarm designed to sound at 500 psi or less, is to be present on the cascade to ensure the adequacy of the air supply.

2.6.2.3 Emergency Escape Units

Self contained, positive pressure emergency escape units are those respirators which contain between 3 and 15 minutes of emergency air. They are to be used for emergency escape and rescue purposes only. They are to remain fully charged while in storage and are to be inspected monthly and after each use. Inspections are to be conducted in a manner

consistent with the provisions established in section 2.10.1 of this program. Storage of these units are to occur in a highly conspicuous and readily accessible location. Under no circumstances is access to this equipment to be impeded by the placement or storage of any other equipment, instrumentation or supplies.

2.6.2.4 Supplied Air Hoods/Helmets

Supplied air hoods or helmets, typically used for abrasive blasting, are designed to provide a continuous air flow to the worker at a rate of no less than 6 CFM (170 liters/min). Volumetric flow rates are to be checked periodically by the project safety representative using a rotameter or some other suitable in-line flow rate monitor. Blowers or other means of supplied air must be situated so as to prohibit the possibility of recycling grit or other containments to the wearer.

2.6.3 General Practice

- o Beards or other excessive facial hair which prevents an adequate face to mask seal are prohibited.
- o The use of contact lenses while wearing any respirator is prohibited.
- o Individuals who wear prescription lenses will require the preparation of custom opthalmic inserts for use with all full face respirators. These will be provided and paid for by the Company.
- o Positive and negative pressure fit tests of all negative pressure respirators are required prior to entering a potentially contaminated environment.
- o Workers are permitted to leave the workplace whenever the experience facial irritation or other discomfort associated with respirator use. Their immediate supervisor must be notified of all such occurrences.
- o Head coverings e.g., tyvek hoods, if used, must not come in contact with the respirator/face sealing surface.
- o Cartridges for air purifying respirators are to be replaced at the first sign of increased breathing resistance or containment breakthrough. The determination of the useful life of a particular cartridge will be based on the extent of use and quantitative estimates of the containments as provided by ambient air monitoring.

2.7 AMBIENT AIR MONITORING

Ambient air monitoring will be conducted periodically by the project safety representative for the purposes of ensuring the adequacy of the respiratory protection provided. The sample strategy selected must be able to provide a representative assessment of the worker's exposure.

Professional judgement may be applied under circumstances where the contaminant generating process in question is sufficiently understood, the rates of generation are predictable and it is unlikely that excursions above the maximum use concentration of the cartridge/respirator assembly will occur.

2.8 BREATHING AIR SYSTEMS

All breathing air used by MK-Ferguson operations will meet grade D specifications or better. Compressed oxygen must not be used with any open-circuit SCBA or airline respirator.

2.8.1 Supply Cylinders

Vendor provided supply cylinders will meet grade D specifications or better. This specification sets limits for selected contaminants which are common constituents of compressed air. These are:

- o 5 mg/m³ condensed hydrocarbons
- o 20 ppm carbon monoxide
- o 1000 ppm carbon dioxide
- o no appreciable odor

The vendor's written verification of the grade of air they are currently providing must be obtained for each lot of supply bottles delivered. These records are to be retained together with the project training, medical certification and worker exposure records by the project safety representative.

2.8.1.1 Cascade Systems (Cylinder Manifold Systems)

- o Cascade systems are to be equipped with a low pressure warning alarm or similar warning device to indicate air pressure in the manifold below 500 psi.
- o When a cascade system is used to supply breathing air, one worker is to be assigned as safety standby within audible range of the low pressure alarm.
- o When a cascade system is used to recharge SCBA air cylinders, it is to be equipped with a high-pressure supply hose and coupling rated at a capacity of at least 3000 psi.

- o Airline couplings are to be incompatible with outlets for other gas-systems to prevent inadvertent servicing of airline respirators with nonrespirable gases or oxygen.

2.8.1.2 Compressors

All breathing air compressors must be situated so as to avoid entry of contaminated air into the system and fitted with filters necessary to ensure that Grade D specifications are met.

The compressor must be fitted with a supply tank large enough to allow escape in the event of failure. Oil lubricated compressors must have a high temperature or carbon monoxide (CO) alarm or both. If no carbon monoxide alarm is present, CO measurements must be determined to ensure that they are not greater than 20 ppm. In-line analysis utilizing colormetric detector tubes sensitive within the required range e.g., National Dragger or equivalent, may be used for this purpose. Carbon monoxide monitoring results are to be recorded and the detector tube sealed and archived. Records of all such determinations are to be retained with the project respirator training/medical records.

2.9 CLEANING AND DISINFECTION

Respirators worn on a regular or daily basis by an employee or subcontractor will be thoroughly cleaned and disinfected at least weekly. Respirators which become visibly contaminated will be cleaned and disinfected at the end of the working day. Those units which could be used by different employees will be cleaned and disinfected after each use.

2.10 INSPECTIONS

2.10.1 Air Purifying Respirators

Routinely used air purifying respirators will be inspected by the wearer for the following before and after each use and by the project safety representative at least monthly:

- o Face piece
 - Cracks, tears, holes or distortion from improper storage
 - Cracked or badly scratched lenses
 - Cracked or broken cartridge receptacles, badly worn threads or missing cartridge gaskets
- o Head straps
 - Breaks

- Loss of elasticity
 - Broken or malfunctioning buckles
 - Excessively worn serrations on the head harness
 - o Exhalation valve
 - Foreign materials such as dust particles or detergent residues under valve seat
 - Cracks or distortion in valve material
 - Missing or defective valve cover
 - Improper valve seating
 - o Air purifying cartridges
 - Incorrect cartridge for the hazard
 - Defective seating in cartridge receptacle
- Defective units are to be removed from service until repaired or replaced.

2.10.1 Supplied Air Systems

SCBA's, airline respirators, and emergency escape units will be inspected before and after each use by the wearer. Documented formal inspections will be performed on a monthly basis by the project safety representative. Areas of particular attention include the following:

- o Face piece
 - Cracks, tears, holes or distortion from improper storage
 - Cracked or badly scratched lenses
 - Incorrectly mounted face piece lens or broken or missing mounting clips
- o Low Pressure Airline
 - Broken or missing end connectors
 - Deterioration, determined by stretching the airline and looking for cracks
- o Air Supply
 - Date of previous hydrostatic testing. Every five years for steel tanks and three years for composite tanks.

- Integrity of air supply lines and end fittings
- Operating condition of all regulators and valves
- Fully pressurized tank status

The inspection records involving all supplied air systems are to be maintained with the respective unit at all times. Defective units are to be red tagged or otherwise taken out of service until repaired.

2.11 RESPIRATOR STORAGE AND MAINTENANCE

All respirators will be stored in a clean and sanitary location away from direct sunlight, extremes in heat and cold and potential contamination. Respirators are to be stored in sealed plastic bags or their original container when not in use. Respirators are not to be stacked or stored beneath heavy objects which could result in distortion of the face piece.

Respirator maintenance will be performed only by the project safety representative or designee who has been trained in respirator repair. Replacement parts, when used will be of the same type and manufacturer.

2.12 RECORDS RETENTION

Record

1. Respirator Certification Records (Appendix C) and results of personal dosimetry

2. Monthly SCBA/SAR/Emergency Escape Unit Inspection Records

3. Program Evaluation

Disposition

Retain copies at the project level. Submit originals to Corporate records retention on the first of each month.

Retain with unit throughout its serviceable life.

Retain copy at the project level. Submit to Corporate records retention on an annual basis.

2.13 PROGRAM EVALUATION

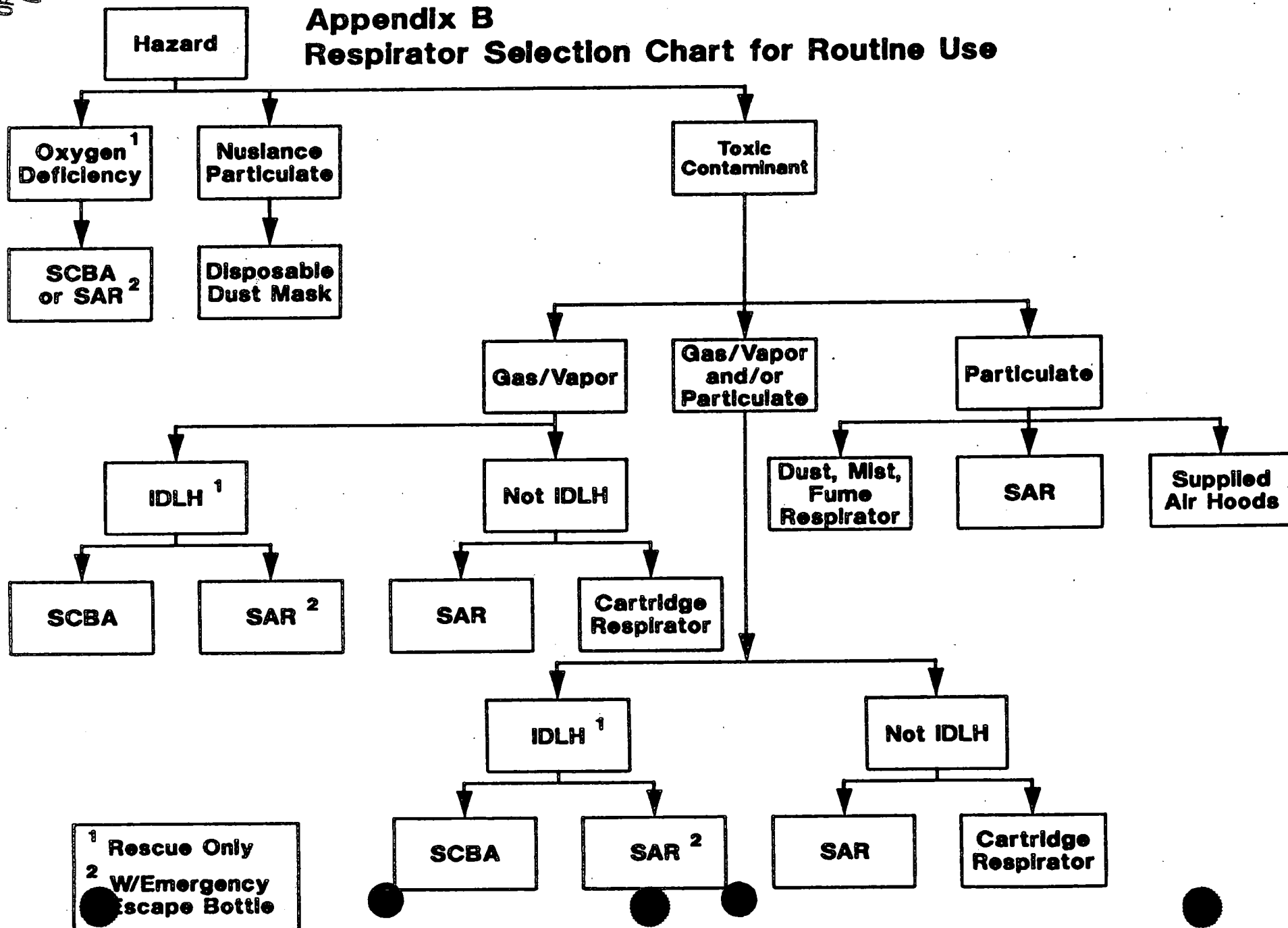
The effectiveness of this respiratory protection program must be evaluated in writing at least annually. This responsibility is to be assumed by the project safety representative or in their absence the project manager. Items to be included in this evaluation process are:

- o Proper use of respirators by employees and subcontractors
- o Examination of respirators in storage
- o Consultation with employees to determine their acceptance or complaints relative to respirator usage
- o Results of medical surveillance, if conducted.

This program must be immediately amended by project management if the evaluation indicates that its execution is inadequate.

Verification of adherence to the requirements of this program will be provided through periodic corporate audits of project operations by the MK-Ferguson Safety Department.

Appendix B Respirator Selection Chart for Routine Use



Respirator Certification Record

SECTION I — GENERAL

Name _____
LAST, FIRST, MIDDLE

S.S.N: _____ - _____ - _____

Date: ____/____/____

Company/Contract No. _____

SECTION II — EMPLOYEE MEDICAL CERTIFICATION

I certify that the individual named above has been evaluated in a manner consistent with the requirements of the MK-Ferguson Respiratory Protection Program and has been found to be qualified/unqualified for use of negative/positive pressure respiratory protection.

____ M.D.

Expiration Date: ____/____/____

SECTION III — RESPIRATOR TRAINING

I certify that I have been thoroughly trained, in a manner consistent with the requirements of the MK-Ferguson Respiratory Protection program regarding the use of the respirator I have been issued. I further certify, that I have also been made aware of its limitations, conditions of use and the established techniques of its proper care and maintenance.

Employee: _____

Date of Training: ____/____/____

SECTION IV - QUALITATIVE FIT TEST

I certify that I have been successfully fit tested against a suitable challenge atmosphere while using an _____, size _____. Respirator number _____.
MANUFACTURER/MODEL S, M, L

Employee: _____

Date of Test: ____/____/____

Fit Test Administrator: _____



Appendix D

Subject

ORIGINAL

Instructor

၂၀၁၂

Location

Date _____

MK-F Respirator Certification Training Attendance Record

PLEASE PRINT CLEARLY

[illegible]

Appendix E

Common Contaminants not Compatible with Air Purifying Respirators

Certain compounds when present in the atmosphere provide very little, if only detectable indication of their presence. Others act to destroy the purification systems of the chemical cartridges used with air purifying respirators. Compounds which suppress the body's ability to detect their presence over extended periods of time and those that may enter the body through pathways other than the respiratory tract also fall into groups that are considered incompatible with air purifying respirators.

Knowing this, it becomes important to provide at least a partial list of those compounds against which air purifying respirators provide little, if any, protection.

1. Acrolein
2. Aniline
3. Arsine
4. Bromine
5. Carbon monoxide
6. Dimethylaniline
7. Dimethyl sulfate
8. Hydrogen cyanide
9. Hydrogen fluoride
10. Hydrogen selenide
11. Hydrogen sulfide
12. Mercury vapor
13. Methanol
14. Methyl bromide
15. Methyl chloride
16. Methylene bisphenyl isocyanate
17. Nickel carbonyl
18. Nitro compounds:
 - Nitrobenzene
 - Nitrogen oxides
 - Nitroglycerin
 - Nitromethane
19. Oxone
20. Phosgene
21. Phosphine
22. Phosphorus trichloride
23. Stibine
24. Sulfur chloride
25. Toluene diisocyanate
26. Vinyl chloride

Be aware that this is by no means a complete list. Should you have any questions regarding the protection provided by an air purifying respirator for a given compound contact the MK-Ferguson Safety Department.

Appendix F

Respirator Qualification Card

MK-Ferguson Respirator Qualification Card	
_____ NAME	_____ PAYROLL NUMBER
_____ DEPARTMENT (CRAFT)	_____ EXPIRATION DATE
_____ INSTRUCTOR	

(FRONT)

	MFG	RESPIRATOR NUMBER, IF APPLICABLE		
SIZE:	S	M	L	XL
TYPE:	½	FF	PAPR	
OTHER: _____				
<ol style="list-style-type: none"> 1. APR's are not to be used in oxygen deficient atmospheres. 2. Excessive facial hair which may effect respirator / face seal is prohibited. 3. Positive and negative pressure fit tests are required prior to use. 4. Use of contact lenses are prohibited. 				

(BACK)

ORIGINAL
(Red)

D

ORIGINAL
(Red)

EXHIBIT D

**MK-FERGUSON COMPANY
HEARING CONSERVATION PROGRAM**

(ISSUANCE PENDING)

ORIGINAL
(Red)

ORIGINAL
(Red)

EXHIBIT E

MANUFACTURERS' INSTRUCTIONS
ON OPERATION & MAINTENANCE OF
PERSONAL PROTECTION EQUIPMENT

(ISSUANCE PENDING)

ORIGINAL
(Red)

F

ORIGINAL
(Red)

EXHIBIT F

MK-FERGUSON COMPANY
MEDICAL SURVEILLANCE PROGRAM

TABLE OF CONTENTS

ORIGINAL
(Red)

<u>Section</u>	<u>Page</u>
3.0 MK-Ferguson Corporate Medical Surveillance Program	3-1
3.1 Purpose	3-1
3.2 Statement of Responsibilities	3-1
3.2.1 Project Management	3-2
3.2.2 Project Industrial Hygienist/Site Safety Representative	3-2
3.2.3 Employees and Subcontractors	3-3
3.3 Program Application	3-3
3.4 Description of Examinations	3-4
3.5 Scope of Surveillance Exams	3-4
3.5.1 Baseline Examinations	3-4
3.5.2 Episodic Exams	3-5
3.5.3 Termination/Annual Exams	3-5
3.6 Abnormal Results	3-5
3.7 Disclosure of Medical Information and Confidentiality	3-6
3.8 Recordkeeping	3-6
3.8.1 General	3-6
3.8.2 OSHA 200 Entries	3-6
3.8.3 Record Disposition Summary	3-6
3.9 Program Review	3-7
 Appendix A Medical Surveillance Instruction Supplement	
Appendix B MK-F Baseline and Interim Medical History Questionnaires	
Appendix C Physical Examination Supplementary Instructions	

3.0 MK-FERGUSON CORPORATE MEDICAL SURVEILLANCE PROGRAM

3.1 PURPOSE

The intent of this policy is to provide direction regarding the design and implementation of a project medical surveillance program. Under certain circumstances, MK-Ferguson Company (MK-F) is legally obligated to provide medical surveillance for workers who may be exposed to a variety of chemical and/or physical agents as a result of their assignments. Medical surveillance is required by the Occupational Safety and Health Administration (OSHA) as a means of monitoring worker exposure to certain toxic substances and also under 29 CFR 1910.120 (f), OSHA's hazardous waste site safety standard. It is important to recognize that personnel who routinely come in contact with hazardous wastes and materials can experience high levels of physiologic stress due to the extensive use of personal protective equipment. Their assigned tasks may also place them in close proximity to or in contact with toxic chemicals, biologic hazards and/or radiation. For these reasons, the project medical surveillance program becomes an essential component of Corporate risk management and the health and safety coverage provided to those individuals working under MK-F direction.

The project medical surveillance program is intended to provide a mechanism by which project management may independently evaluate the effects of an inadvertent exposure to a toxic agent, due for instance, to the failure of personal protective equipment. It also provides supporting documentation in the event of future litigation and fulfills the requests of federal and state agencies for such information. If designed properly, the project medical surveillance program will also serve as a convenient means of meeting the medical requirements of OSHA's respiratory protection and hearing conservation standards which would typically apply to these operations.

3.2 STATEMENT OF RESPONSIBILITIES

3.2.1 Project Management

Project management is ultimately responsible for the execution of the project medical surveillance program in accordance with the objectives established by Company policy. Those elements to which project management will be held accountable in support of these objectives will include the following:

- o Ensure that an approved medical surveillance program has been established prior to the execution of all projects which legally require such coverage.
- o Identify all workers who may potentially be covered under the intent of this program.
- o Ensure that those individuals so identified actively participate in project medical surveillance program.
- o Ensure that all documentation and records resulting from the execution of this program remain confidential and that they are managed in a manner consistent with established procedures.

3.2.2 Project Industrial Hygienist/Site Safety Representative

The project industrial hygienist or site safety representative is responsible for execution of the technical aspects of the medical surveillance program. Specific duties assumed by this individual include the following:

- o Assist project management in determining the applicability of this medical surveillance program to the project's anticipated scope of work.
- o Coordinate the development of the project medical surveillance program with a Board Certified or other qualified physician.
- o Ensure that the examining physician is in receipt of a copy of the appropriate regulations where medical surveillance is legally required.
- o Provide the examining physician with a detailed description of the duties of each worker, the personnel protective equipment to be worn, the contaminants to which he/she may be exposed and a relative indication of their exposure potential.
- o Amend the scope of this Corporate program to include supplementary screening and diagnostic testing as dictated by project specific information.
- o Assist project management in ensuring that all targeted workers falling under the intent of this policy are actively participating in the medical surveillance program.
- o Ensure that all annual, periodic, episodic and termination examinations are performed on a timely basis.
- o Maintain all necessary documentation in accordance with the provisions established under this program.
- o Modify the medical surveillance program to reflect changes in the project's scope of work as it effects worker exposure potential.
- o Provide recommendations to project management regarding the occupational significance of worker medical surveillance results generated by this program.
- o Ensure that each worker is informed of the results of the medical surveillance examination.
- o Obtain the examining physician's opinion for each targeted worker which attests to their ability to work in a potentially contaminated area.
- o Ensure the confidentiality of all medical records and related information resulting from the administration of this medical program.
- o Facilitate the making of all appointments with the examining physician necessary to ensure the efficient use of time and resources.
- o Ensure that medical surveillance records are released to all short term workers i.e., those with less than one year of service, at the termination of their employment.
- o Facilitate the submittal of all medical records to Corporate for long term records retention.
- o Conduct formal, written program reviews on an annual basis or at a frequency necessary to ensure the effectiveness of the program.

- o Request verification of receipt of all medical surveillance records submitted to long term storage.

3.2.3 Employees and Subcontractors

- o Provide truthful and complete responses to all inquires and requests for medical information necessary to the effective execution of this program.
- o Abide by all medical pre-examination requirements i.e., fasting and dietary modifications, necessary to ensure representative results of all clinical testing.
- o Ensure punctuality with all examination appointments made in conjunction with this program.
- o Report any suspected exposures or symptoms to your supervisor regardless of degree.
- o Bring any unusual physical or psychological conditions to the attention of the examining physician.

3.3 Program Application

A project medical surveillance program is one that must be developed in close affiliation with the project work plan or any activity requiring such coverage. This will assist in providing the most accurate estimate of an individual worker's exposure potential and, more clearly define the scope of the medical surveillance program prior to the onset of the project. The objective of medical surveillance is to provide an indication, within certain preimposed limits, of certain physiologic episodes as detected in blood, urine or exhaled air which would be indicative of a worker's exposure to a given chemical agent(s).

The need for implementing a medical surveillance program is dictated by either existing legislation or the associated long-term risks of conducting certain work as perceived by the Company. As such, the requirements of this policy may apply to the operations of MK-Ferguson if:

- 1) The project or activity involves a remedial investigation or other response action conducted under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or
- 2) Corrective actions taken in clean-up operations under the Resource Conservation and Recovery Act (RCRA) or
- 3) Hazardous waste site investigations that have been designated for clean-up by state or local governmental authorities and the potential exists that workers may be exposed to hazardous substances or other health hazards at or above the established permissible exposure limits for those substances, without regard for respirators, for 30 days or more or
- 4) The activity involves any work with the highly toxic compounds or suspected human carcinogens listed under 29 CFR 1910.1001-1047.

3.4 DESCRIPTION OF EXAMINATIONS

The types of examinations designed to support the medical surveillance program are, at the minimum, to include the following:

- o Baseline Examination - The baseline or preemployment screening examination is to be administered prior to the worker reporting to the jobsite.
- o Episodic Examination - The episodic examination will be conducted upon notification of project management and/or project safety representative by a worker indicating that he or she has developed signs or symptoms related to possible over exposure to hazardous substances or that an unprotected worker has been exposed in an emergency situation.
- o Termination Examination - The termination examination will be administered at the termination of a worker's employment or in the event of his/her reassignment to an area where the worker would not be covered by this program.
- o Annual Examination - The annual exam will be conducted at least once every 12 months for any worker covered under this program.

3.5 SCOPE OF MEDICAL SURVEILLANCE EXAMS

3.5.1 Baseline Examinations

The baseline medical surveillance examinations required for work on projects with components addressed in section 3.3 (1) (2) and (3), of this program are to include, at the minimum, the following tests and clinical determinations.

- o Comprehensive review of medical history (Appendix A)
- o Complete physical exam with emphasis on the cardiovascular and pulmonary systems.
- o Completed blood count (CBC)
- o SMA 22 or 24 biochemical profile
- o Pulmonary function testing
- o Resting electrocardiogram
- o Creatinine clearance
- o Complete urinalysis
- o Baseline audiogram
- o Vision screening

Supplemental tests and determinations are to be made on a project specific basis. The scope of the additional parameters will be based upon the results of any available environmental analyses, site history, current on-site activities and the associated potential for heat related disorders. Any additional tests, if warranted, will be specified by a board certified, occupational physician working in conjunction with the project industrial hygienist or site safety representative.

Baseline examinations for those compounds listed under section 3.4 (4) are to be conducted in accordance with the legislative citing.

Specific directives pertaining to occupational exposure to compounds such as asbestos and lead etc., will be issued as future addenda to this program.

3.5.2 Episodic Examinations

The scope of any episodic examinations will be left to the discretion of the examining physician. It will undoubtedly be based, however, on the results of applicable environmental analyses, material safety data sheets pertaining to the compounds which the worker had been handling or other supporting documentation. As such, it is critical that the project industrial hygienist or project safety representative convey any available information to the examining physician in order to facilitate the testing or treatment process.

3.5.3 Termination/Annual Examinations

The annual and termination exams are to be complementary in scope with the baseline exams to the degree sufficient to allow comparison of individual biologic parameters. Additional testing for the purposes the further diagnosis of occupationally induced or significant abnormalities will be permitted at the discretion of the examining physician. The interim medical history questionnaire is to be completed and submitted to the examining physician prior to each examination (Appendix B).

3.6 ABNORMAL MEDICAL SURVEILLANCE RESULTS

In general, whenever any medical test which is of occupational significance yields as abnormal result, the test will be repeated. The project industrial hygienist or project safety representative will remain current relative to the medical status of each worker participating in the program. If advised of an abnormal result, this individual may permit additional testing under the advise of the examining physician.

Whenever medical monitoring is substantiated and indicates a problem which is considered occupationally significant, the worker may either be restricted or excluded from areas which are potentially contaminated or thought to compromise his/her safety. The ultimate decision of worker disposition will rest with the examining physician.

3.7 DISCLOSURE OF MEDICAL INFORMATION AND CONFIDENTIALITY

The personal medical information obtained through the MK-F medical program shall be treated as strictly confidential and may be released only through adherence to the guidelines for "Disclosure of Medical Information" further described in Appendix A.

Consistent with this policy, all personnel will be requested to complete a "Medical Record Release Authorization" form and submit it to the examining physician with a completed medical history questionnaire at the time of the exam. With this release, the examining physician will

be able to inform each employee and project management of an individual's physical status and ability to perform work with or without any specified work restrictions.

The employee's personal copy of the completed medical history questionnaire and/or results of the medical surveillance examination may be requested from the examining physician by completing a "Request for Personal Medical Records" form found in Appendix A.

3.8 RECORDKEEPING

3.8.1 General

The distribution of medical records resulting from this program is to be limited to the worker, their authorized union representatives and the Occupational Safety and Health Administration, when requested. Original records in the form of baseline, annual, termination and/or episodic examination results are to be retained by the examining physician. Copies of all such records are then to be submitted, in accordance with the MK-F Medical Records Disclosure Policy, to Corporate records retention for long term (30 year) storage. Medical records are to be provided to all short term workers i.e., those with less than one year of service at the time of their termination. Copies of any medical opinions and/or work releases provided to the project by the examining physician will be retained with the project for its duration. Copies of all such documents are then to be submitted to corporate records retention for archiving.

3.8.2 OSHA 200 Entries

If, in the examining physician's opinion, it is decided that an occupational illness has occurred, it will be the responsibility of the project industrial hygienist or project safety representative to determine whether it is OSHA recordable per 29 CFR Part 1904 and if so, to ensure that OSHA 200 form has been completed.

3.8.3 Record Disposition Summary

<u>Document</u>	<u>Disposition</u>
1) Completed Medical History Questionnaires	Retain originals with examining physician. Copies to corporate long term records retention.
2) Result of Medical Surveillance Examinations.	
3) Medical opinions or work releases	
4) General Medical Correspondence	
5) Annual and Periodic Program Reviews	Retain original reports with project. Submit copies to Corporate for review.

- 6) Medical records associated with short term employees, i.e., less than one year of service.

Provide copies to each employee at their termination or transfer.

3.9 PROGRAM REVIEW

The medical surveillance program is to be reviewed on an annual basis or more frequently if conditions warrant. The project industrial hygienist/safety representative will be responsible for ensuring that each accident, exposure or illness is promptly investigated to determine the cause with modifications made to health and safety procedures, as required. Other areas which are to be evaluated in the review of this program include the following:

- o Evaluation of the applicability and effectiveness of project specific medical testing as it relates to available environmental data and worker exposure potential.
- o Addition or deletion of medical tests as suggested by current industrial hygiene or environmental data.
- o Review emergency treatment procedures and updating lists of emergency contacts.

Appendix A

MEDICAL SURVEILLANCE INSTRUCTION SUPPLEMENT

Introduction

A medical surveillance program has been established to assist MK-Ferguson with the recognition, evaluation and control of chemical and physical agents which may be encountered in the work place. Associated with this program is the requirement that all employees working in potentially hazardous environments learn to comply with all safety and health rules applicable to their work as well as the general safety of co-workers and the public.

Your participation in this program is determined by Project Management. All costs resulting from your participation in this program will be assumed by MK-Ferguson Company and the time taken away from work will not result in a loss in pay. It will, however, require the completion of the attached medical history questionnaire, submission to a physical examination and an assessment of a predetermined set of clinical evaluations. The scope of the examination is based upon the characteristics of your job coupled with your anticipated potential of exposure to chemical and physical agents as determined by project management, the project industrial hygienist and the examining physician.

Your health and ability to perform safely is of paramount concern to the Company. Based on your medical history, the results of your examination and its associated tests, the examining physician will be able to establish a medical baseline or physiologic profile. You should understand that knowledge of this medical baseline is of considerable value to both yourself and MK-Ferguson. Its value and use will include but may not be solely limited to the following:

- 1) Determine your physical ability to use a respirator
- 2) Determine your ability to perform work while wearing protective equipment
- 3) Determine possible sensitivities and potential reactions to substances that may be encountered in the workplace
- 4) Establish a physiologic baseline to assess the degree and/or effects of inadvertent exposures to hazardous materials
- 5) Support future epidemiological studies
- 6) Establish a personal health maintenance baseline

Medical Information Disclosure and Confidentiality

The personal medical information obtained through the project medical surveillance program shall be treated as strictly confidential and may be released only through adherence to the Corporate "Disclosure of Medical Information" guidelines.

Consistent with this policy, you are requested to complete the attached Medical Record Release Authorization form and submit it to the examining physician with the completed questionnaire at the time of the physical. With this release, the examining physician will be able to inform yourself and project management of your physical status and ability to perform work on the project site with and/or without any specified work restrictions.

A personal copy of your medical questionnaire and/or medical exam may be requested from the examining physician by completing the "Request for Personal Medical Records" form. The form may be obtained from and submitted to the project manager, project industrial hygienist and/or examining physician.

Instructions for Completion of the Medical Questionnaire and Preparation for the Physical Exam

Please review and complete the attached questionnaire and give it to the examining physician at the time of your physical. Answer the form as completely and accurately as possible.

In addition, please read and follow the Physical Exam Supplementary Instructions (Appendix C) that includes temporary diet restriction, fasting and biologic sampling requirements.

Thank you for your assistance and cooperation. Should you have any questions concerning the medical surveillance program, please contact your project manager, project industrial hygienist, and/or the examining physician. Please be aware that non-compliance with the terms of the medical surveillance program may result in work restrictions, reassignment or other appropriate action taken that is deemed reasonable and necessary to ensure your safety.

Appendix A
Medical Record Release Authorization

I _____ hereby authorize and request
(full name of employee/patient)

_____ to release to _____
(examining physician)

(name and title of individuals to receive records)

the following occupational medical records and/or portions thereof, as described below, from my personal medical records: (Describe, in general the information to be released and any specific instructions; such as limits in terms, the duration of this release, etc.).

I give my permission for use of these medical records as follows:

- ___ Evaluation of personal health;
- ___ Analysis of medical and/or exposure records;
- ___ Other (describe): _____

I do not authorize release of records for any other use of redisclosure.

I further understand that any use of my medical records for medical and/or epidemiologic studies authorized by this release is contingent upon the conscious and thorough masking of all references to my identity, including name, address, employee number, social security number, and any other identifying characteristics.

* Note: Use the space below to list specific restrictions, if any, you may have concerning your medical records. For example, you may specify an authorization; identify specific test results or sections of the medical questionnaire or exam that you do not want to authorize for release through this examination.

ORIGINAL
(Red)

Medical Record Release Authorization

Full name of employee or legal representative

Signature

Date

APPENDIX B

ORIGINAL
(Red)

THIS MEDICAL QUESTIONNAIRE WILL BE COMPLETED BY
ALL NEW EMPLOYEES
WHOSE FIELD DUTIES REQUIRE USING A RESPIRATOR.

INITIAL MEDICAL QUESTIONNAIRE

1. EMPLOYEE'S NAME _____ 2. DATE _____
 3. SOCIAL SECURITY No.: _____ 4. CLOCK (I.D.) No.: _____
 5. PRESENT OCCUPATION: _____
 6. PLANT (COMPANY): _____
 7. ADDRESS: _____
 8. _____ (zip code) _____
 9. TELEPHONE No.: _____ 10. INTERVIEWER: _____
 11. DATE OF BIRTH: _____ 12. PLACE OF BIRTH: _____
 13. SEX. MALE ☐ FEMALE ☐
 14. MARITAL STATUS: SINGLE ☐ MARRIED ☐ WIDOWED ☐ SEPARATED/DIVORCED ☐
 15. RACE: WHITE ☐ BLACK ☐ ASIAN ☐ HISPANIC ☐ INDIAN ☐ OTHER ☐ _____
 16. HIGHEST SCHOOL GRADE COMPLETED. _____ (Exp. 12 yrs is completion of high school)

OCCUPATIONAL HISTORY

- 17A. Have you ever worked full time (30 hours per week or more) for 6 months or more? Yes ☐ No ☐

IF YES TO 17A:

- B. Have you ever worked for a year or more in any dusty job? Yes ☐ No ☐ Does Not Apply ☐
 Specify job/industry _____ Total years worked _____
 Was dust exposure: Mild ☐ Moderate ☐ Severe ☐
 C. Have you ever been exposed to gas or chemical fumes in your work? Yes ☐ No ☐
 Specify job/industry _____ Total Years Worked _____
 Was exposure: Mild ☐ Moderate ☐ Severe ☐
 D. What has been your usual occupation or job — the one you have worked at the longest?

1. Job Occupation _____
 2. Number of years employed in this occupation _____
 3. Position/job title _____
 4. Business, field or industry _____

(Record on lines the years in which you have worked in any of these industries, e.g., 1960-1969)

Have you ever worked:	Yes	No	From	To
E. In a mine?	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
F. In a quarry?	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
G. In a foundry?	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
H. In a pottery?	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
I. In a cotton, flax or hemp mill?	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____
J. With asbestos?	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____

18. PAST MEDICAL HISTORY

- A. Do you consider yourself to be in good health? Yes ☐ No ☐
 If "NO" state reason _____
 B. Have you any defect of vision? ☐ Yes ☐ No ☐
 If "YES" state nature of defect _____
 C. Have you any hearing defect? ☐ Yes ☐ No ☐
 If "YES" state nature of defect _____
 D. Are you suffering from or have you ever suffered from
 a. Epilepsy (or fits, seizures, convulsions?) Yes ☐ No ☐
 b. Rheumatic fever? ☐ Yes ☐ No ☐
 c. Kidney disease? ☐ Yes ☐ No ☐
 d. Bladder disease? ☐ Yes ☐ No ☐
 e. Diabetes? ☐ Yes ☐ No ☐
 f. Jaundice? ☐ Yes ☐ No ☐

19. CHEST COLDS AND CHEST ILLNESSES

- 19A. If you get a cold, does it usually go to your chest? (Usually means more than $\frac{1}{2}$ the time) Yes ☐ No ☐
Do not get colds
- 20A. During the past 3 years, have you had any chest illnesses that have kept you off work, indoors at home, or in bed? Yes ☐ No ☐
- IF YES TO 20A:
- B. Did you produce phlegm with any of these chest illnesses? Yes ☐ No ☐ Does Not Apply ☐
- C. In the last 3 years, how many such illnesses with (increased) phlegm did you have which lasted a week or more? Number of illnesses _____ No such illnesses _____
21. Did you have any lung trouble before the age of 16? Yes ☐ No ☐
22. Have you ever had any of the following?
- 1A. Attacks of bronchitis? Yes ☐ No ☐
- IF YES TO 1A:
- B. Was it confirmed by a doctor? Yes ☐ No ☐ Does Not Apply ☐
- C. At what age was your first attack? Age in Years _____ Does Not Apply ☐
- 2A. Pneumonia (include bronchopneumonia)? Yes ☐ No ☐
- IF YES TO 2A:
- B. Was it confirmed by a doctor? Yes ☐ No ☐ Does Not Apply ☐
- C. At what age did you first have it? Age in Years _____ Does Not Apply ☐
- 3A. Hay Fever? Yes ☐ No ☐
- IF YES TO 3A:
- B. Was it confirmed by a doctor? Yes ☐ No ☐ Does Not Apply ☐
- C. At what age did it start? Age in Years _____ Does Not Apply ☐
- 23A. Have you ever had chronic bronchitis? Yes ☐ No ☐
- IF YES TO 23A:
- B. Do you still have it? Yes ☐ No ☐ Does Not Apply ☐
- C. Was it confirmed by a doctor? Yes ☐ No ☐ Does Not Apply ☐
- D. At what age did it start? Age in Years _____ Does Not Apply ☐
- 24A. Have you ever had emphysema? Yes ☐ No ☐
- IF YES TO 24A:
- B. Do you still have it? Yes ☐ No ☐ Does Not Apply ☐
- C. Was it confirmed by a doctor? Yes ☐ No ☐ Does Not Apply ☐
- D. At what age did it start? Age in Years _____ Does Not Apply ☐
- 25A. Have you ever had asthma? Yes ☐ No ☐
- IF YES TO 25A:
- B. Do you still have it? Yes ☐ No ☐ Does Not Apply ☐
- C. Was it confirmed by a doctor? Yes ☐ No ☐ Does Not Apply ☐
- D. At what age did it start? Age in Years _____ Does Not Apply ☐
- E. If you no longer have it, at what age did it stop? Age Stopped _____ Does Not Apply ☐
26. Have you ever had:
- A. Any other chest illness? Yes ☐ No ☐
If yes, please specify _____
- B. Any chest operations? Yes ☐ No ☐
If yes, please specify _____
- C. Any chest injuries? Yes ☐ No ☐
If yes, please specify _____
- 27A. Has a doctor ever told you that you had heart trouble? Yes ☐ No ☐
- IF YES TO 27A:
- B. Have you ever had treatment for heart trouble in the past 10 years? Yes ☐ No ☐ Does Not Apply ☐
- 28A. Has a doctor ever told you that you had high blood pressure? Yes ☐ No ☐ Does Not Apply ☐
- IF YES TO 28A:
- B. Have you had any treatment for high blood pressure (hypertension) in the past 10 years? Yes ☐ No ☐ Does Not Apply ☐
29. When did you last have your chest x-rayed? (Year) _____
30. Where did you last have your chest x-rayed (if known)? _____
What was the outcome? _____

FAMILY HISTORY

31. Were either of your natural parents ever told by a doctor that they had a chronic lung condition such as

FATHER

MOTHER

Yes

No

Don't
Know

Yes

No

Don't
Know

A. Chronic Bronchitis?

B. Emphysema?

C. Asthma?

D. Lung Cancer?

E. Other Chest conditions?

F. Is parent currently alive?

G. Please Specify

Age if Living

Age at Death

Don't Know

Age if Living

Age at Death

Don't Know

H. Please specify cause of death

COUGH

32A. Do you usually have a cough? (Count a cough with first smoke or on first going out of doors. Exclude clearing of throat.)
(If no, skip to question 32C.)Yes ☐ No ☐

B. Do you usually cough as much as 4 to 6 times a day 4 or more days out of the week?

Yes ☐ No ☐

C. Do you usually cough at all on getting up or first thing in the morning?

Yes ☐ No ☐

D. Do you usually cough at all during the rest of the day or at night?

Yes ☐ No ☐

IF YES TO ANY OF ABOVE (32A, B, C, or D), ANSWER THE FOLLOWING. IF NO TO ALL, CHECK DOES NOT APPLY AND SKIP TO NEXT SECTION.

E. Do you usually cough like this on most days for 3 consecutive months or more during the year?

Yes ☐ No ☐Does Not Apply ☐

F. For how many years have you had the cough?

Number of Years _____ Does Not Apply ☐

33A. Do you usually bring up phlegm from your chest? (Count phlegm with the first smoke or on first going out of doors. Exclude phlegm from the nose. Count swallowed phlegm.) (If no, skip to 33C.)

Yes ☐ No ☐

B. Do you usually bring up phlegm like this as much as twice a day 4 or more days out of the week?

Yes ☐ No ☐

C. Do you usually bring up phlegm at all on getting up or first thing in the morning?

Yes ☐ No ☐

D. Do you usually bring up phlegm at all during the rest of the day or at night?

Yes ☐ No ☐

IF YES TO ANY OF THE ABOVE (33A, B, C, or D), ANSWER THE FOLLOWING. IF NO TO ALL, CHECK DOES NOT APPLY AND SKIP TO 34A

E. Do you bring up phlegm like this on most days for 3 consecutive months or more during the year?

Yes ☐ No ☐

F. For how many years have you had trouble with phlegm?

Number of Years _____ Does Not Apply ☐

EPISODES OF COUGH AND PHLEGM

34A. Have you had periods or episodes of (increased) cough and phlegm lasting for 3 weeks or more each year? (For persons who usually have cough and/or phlegm)

Yes ☐ No ☐

IF YES TO 34A

B. For how long have you had at least 1 such episode per year?

Number of Years _____ Does Not Apply ☐

WHEEZING

35A. Does your chest ever sound wheezy or whistling

1. When you have a cold?

Yes ☐ No ☐

2. Occasionally apart from colds?

Yes ☐ No ☐

3. Most days or nights?

Yes ☐ No ☐

IF YES TO 1, 2, or 3 IN 35A

B. For how many years has this been present?

Number of Years _____ Does Not Apply ☐

36A. Have you ever had an attack of wheezing that made you feel short of breath?

Yes ☐ No ☐

IF YES TO 36A

B. How old were you when you had your first such attack?

Age in Years _____ Does Not Apply ☐

C. Have you had 2 or more such episodes?

Yes ☐ No ☐Does Not Apply ☐

D. Have you ever required medicine or treatment for the(ose) attack(s)?

Yes ☐ No ☐Does Not Apply ☐

BREATHLESSNESS

37. If disabled from walking by any condition other than heart or lung disease, please describe and proceed to question 39A
Nature of condition(s) _____

- 38A Are you troubled by shortness of breath when hurrying on the level or walking up a slight hill? Yes ☐ No ☐
- IF YES TO 38A
- B. Do you have to walk slower than people of your age on the level because of breathlessness? Yes ☐ No ☐ Does Not Apply ☐
- C. Do you ever have to stop for breath when walking at your own pace on the level? Yes ☐ No ☐ Does Not Apply ☐
- D. Do you ever have to stop for breath after walking about 100 yards (or after a few minutes) on the level? Yes ☐ No ☐ Does Not Apply ☐
- E. Are you too breathless to leave the house or breathless on dressing or climbing one flight of stairs? Yes ☐ No ☐ Does Not Apply ☐

TOBACCO SMOKING

- 39A. Have you ever smoked cigarettes? (No means less than 20 packs of cigarettes or 12 oz. of tobacco in a lifetime or less than 1 cigarette a day for 1 year.) Yes ☐ No ☐
- IF YES TO 39A
- B. Do you now smoke cigarettes (as of one month ago)? Yes ☐ No ☐
- C. How old were you when you first started regular cigarette smoking? Age in Years _____ Does Not Apply ☐
- D. If you have stopped smoking cigarettes completely, how old were you when you stopped? Age Stopped _____ Check if still smoking ☐ Does Not Apply ☐
- E. How many cigarettes do you smoke per day now? Cigarettes per day _____ Does Not Apply ☐
- F. On the average of the entire time you smoked, how many cigarettes did you smoke per day? Cigarettes per day _____ Does Not Apply ☐
- G. Do or did you inhale the cigarette smoke? Does Not Apply ☐ Not At All ☐ Slightly ☐ Moderately ☐ Deeply ☐

- 40A Have you ever smoked a pipe regularly? (Yes means more than 12 oz. of tobacco in a lifetime.) Yes ☐ No ☐
- IF YES TO 40A:

FOR PERSONS WHO HAVE EVER SMOKED A PIPE

- B 1. How old were you when you started to smoke a pipe regularly? Age _____
2. If you have stopped smoking a pipe completely, how old were you when you stopped? Age Stopped _____
- Check if still Smoking a pipe ☐ Does Not Apply ☐
- C. On the average over the entire time you smoked a pipe, how much pipe tobacco did you smoke per week? (a standard pouch of tobacco contains 1-1/2 oz.) Oz. per week _____ Does Not Apply ☐
- D. How much pipe tobacco are you smoking now? Oz. per week _____ Not currently Smoking a pipe ☐
- E. Do you or did you inhale the pipe smoke? Never smoked ☐ Not at all ☐ Slightly ☐ Moderately ☐ Deeply ☐

- 41A. Have you ever smoked cigars regularly? (Yes means more than 1 cigar a week for a year) Yes ☐ No ☐
- IF YES TO 41A FOR PERSONS WHO HAVE EVER SMOKED CIGARS

- B 1. How old were you when you started smoking cigars regularly? Age _____
2. If you have stopped smoking cigars completely, how old were you when you stopped? Age Stopped _____
- Check if still smoking cigars ☐ Does Not Apply ☐
- C. On the average over the entire time you smoked cigars, how many cigars did you smoke per week? Cigars per week _____ Does Not Apply ☐
- D. How many cigars are you smoking per week now? Cigars per week _____
- Check if not smoking cigars currently ☐
- E. Do you or did you inhale the cigar smoke? Never smoked ☐ Not at all ☐ Slightly ☐ Moderately ☐ Deeply ☐

Signature _____

Date _____

THIS PERIODIC MEDICAL QUESTIONNAIRE WILL BE COM-
PLETED BY ALL EMPLOYEES
WHOSE FIELD DUTIES REQUIRE USING A RESPIRATOR.

ORIGINAL
(Red)

PERIODIC MEDICAL QUESTIONNAIRE

1. NAME: _____
2. SOCIAL SECURITY: _____
3. CLOCK NUMBER _____
4. PRESENT OCCUPATION _____
5. PLANT _____
6. ADDRESS _____
7. _____ (Zip Code) _____
8. TELEPHONE NUMBER _____
9. INTERVIEWER _____ 10. DATE _____

11. What is your marital status?
1. Single ☐ 2. Married ☐ 3. Widowed ☐
4. Separated/Divorced ☐

12. OCCUPATIONAL HISTORY

- 12A. In the past year, did you work full time (30 hours per week or more) for 6 months or more? 1. Yes ☐ 2. No ☐
IF YES TO 12A:
12B. In the past year, did you work in a dusty job? 1. Yes ☐ 2. No ☐ 3. Does Not Apply ☐
12C. Was dust exposure: 1. Mild ☐ 2. Moderate ☐ 3. Severe ☐
12D. In the past year, were you exposed to gas or chemical fumes in your work? 1. Yes ☐ 2. No ☐
12E. Was exposure: 1. Mild ☐ 2. Moderate ☐ 3. Severe ☐
12F. In the past year, what was your: 1. Job/occupation _____
2. Position/job title? _____

13. RECENT MEDICAL HISTORY

- 13A. Do you consider yourself to be in good health? Yes ☐ No ☐
If NO, state reason _____
13B. In the past year, have you developed:
- | | Yes | No |
|------------------|--------------------------|--------------------------|
| Emphysema? | <input type="checkbox"/> | <input type="checkbox"/> |
| Rheumatic fever? | <input type="checkbox"/> | <input type="checkbox"/> |
| Kidney disease? | <input type="checkbox"/> | <input type="checkbox"/> |
| Bladder disease? | <input type="checkbox"/> | <input type="checkbox"/> |
| Diabetes? | <input type="checkbox"/> | <input type="checkbox"/> |
| Jaundice? | <input type="checkbox"/> | <input type="checkbox"/> |
| Cancer? | <input type="checkbox"/> | <input type="checkbox"/> |

14. CHEST COLDS AND CHEST ILLNESSES

14A. If you get a cold, does it usually go to your chest?
(usually means more than 1/2 the time)1. Yes ☐ 2. No ☐ 3. Don't get colds ☐

15A. During the past 3 years, have you had any chest illnesses that have kept you off work, indoors at home, or in bed?

1. Yes ☐ 2. No ☐ 3. Does Not Apply ☐

IF YES TO 15A:

15B. Did you produce phlegm with any of these chest illnesses?

1. Yes ☐ 2. No ☐ 3. Does Not Apply ☐

15C. In the last 3 years, how many such illnesses with (increased) phlegm did you have which lasted a week or more?

Number of illnesses _____

No such illnesses _____

16. RESPIRATORY SYSTEM

In the past year, have you had:

Further Comment on Positive
Answers

	Yes	No
Asthma	<input type="checkbox"/>	<input type="checkbox"/>
Bronchitis	<input type="checkbox"/>	<input type="checkbox"/>
Hay Fever	<input type="checkbox"/>	<input type="checkbox"/>
Other Allergies	<input type="checkbox"/>	<input type="checkbox"/>
Pneumonia	<input type="checkbox"/>	<input type="checkbox"/>
Tuberculosis	<input type="checkbox"/>	<input type="checkbox"/>
Chest Surgery	<input type="checkbox"/>	<input type="checkbox"/>
Other Lung Problems	<input type="checkbox"/>	<input type="checkbox"/>
Heart Disease	<input type="checkbox"/>	<input type="checkbox"/>

Do you have:

Further Comment on Positive
Answers

	Yes	No
Frequent colds	<input type="checkbox"/>	<input type="checkbox"/>
Chronic cough	<input type="checkbox"/>	<input type="checkbox"/>
Shortness of breath when walking or climbing one flight of stairs	<input type="checkbox"/>	<input type="checkbox"/>
Do you:		
Wheeze	<input type="checkbox"/>	<input type="checkbox"/>
Cough up phlegm	<input type="checkbox"/>	<input type="checkbox"/>
Smoke Cigarettes	<input type="checkbox"/>	<input type="checkbox"/>

Packs per day _____ How many years _____

Date _____

Signature _____

Appendix C
PHYSICAL EXAMINATION SUPPLEMENTARY INSTRUCTIONS

In preparation for the medical surveillance examination please make note of the following:

DIETARY

- 1) Abstain from beverage alcohol consumption for at least 48 hours prior to the examination. Alcohol has a variable effect on blood chemistry which may result in inaccurate test results.
- 2) If you are going to be tested for arsenic (MK-F will inform you if you are) do not consume seafood for at least 72 hours before the collection of your 24 hour urine specimen. Seafood contains significant amounts of arsenic which may cause bias in the determination of your baseline for that metal.
- 3) Fast for 12-14 hours prior to the examination. You may drink water, black coffee or clear tea during the fasting period. Do not restrict the consumption of fluids during the fasting period.

Collection of 24 Hour Urine Specimen for Heavy Metal Analysis

Collect and save all urine for exactly 24 hours. To begin the time of collection, void completely and discard. Begin the 24 hour period at this time. Void into the special container provided. Make sure you have this container readily accessible at all times. Make sure to drink an adequate amount of liquids.

Stop the 24 hour collection exactly 24 hours after the first voiding (the one that was discarded). You should refrigerate the collected urine to minimize bacterial growth.

If you forget to save all your urine, you will need to discard all of it and restart your 24 hour collection. It is important that contamination of collection containers does not occur. DO NOT RINSE THEM IN TAP WATER AND DO NOT USE OTHER TYPES OF COLLECTION CONTAINERS. These containers are chemically cleaned.

If you exceed the 24 hour period, record the exact collection times. The urine can still be used for testing, but the physician will need the exact times.

ORIGINAL
(Red)

ORIGINAL
(Red)

EXHIBIT G

MK-FERGUSON COMPANY
CONFINED SPACE ENTRY PROCEDURE

TABLE OF CONTENTS

<u>Section</u>	<u>Content</u>	<u>Page</u>
13.1	Scope and Intent	1
13.2	References	1
13.3	Responsibilities	1
13.3.1	Project Managers, Construction Managers and Project Superintendents	1
13.3.2	Site Safety Supervisor/Industrial Hygienist	2
13.3.3	Competent Person	2
13.3.4	Employees	3
13.4	Definitions	3
13.4.1	Attendant	3
13.4.2	Confined Space	3
13.4.3	Entry	4
13.4.4	Entry Permit	4
13.4.5	Hazardous Atmosphere	4
13.4.6	Competent Person	4
13.4.7	Lower Explosive Limit	4
13.5	Entry Requirements	4
13.5.1	Preparation prior to entry of a confined space requiring a permit	4
13.5.2	General requirements and procedures for permit entry into a confined space	6
13.5.3	General requirements and procedures non-permit entry into a confined space	6

Appendix A - Sample Confined Space Entry Permit

Section XIX

13.0 MK-Ferguson Confined Space Entry Procedures

13.1 SCOPE AND INTENT

It is the intent of MK-Ferguson Company to ensure the safety and health of all employees entering confined spaces. Consistent with this intent, is the need to develop a well defined standard operating procedure which governs the identification and control of confined space entries; establishes the requisite training for entries and emergency rescue; provides assurance that all mechanical, physical, electrical and chemical hazards have been controlled and/or monitored; and to establish a mechanism to ensure that the procedures governing confined space entries have been followed.

13.2 REFERENCES

Criteria Document, National Institute for Occupational Safety and Health; Publication No. 80-106; Working in Confined Spaces.

29CFR1910.252(d)(4), (e) and (f), Welding in Confined Spaces.

13.3 RESPONSIBILITIES

13.3.1 Project Managers, Construction Managers and Project Superintendents

Project management is ultimately responsible for assuring adherence to the administrative elements of this standard operating procedure on projects where confined space entry may be required. More specifically, those elements of the program which project management is responsible include the following:

- o Identifies tasks which may involve worker entry into a confined space, and assures all proper permits are obtained.
- o Assures the maintenance of a current classification file of all confined spaces which may be potentially occupied throughout the course of the project.
- o Reviews procedures and audits field execution of confined space entries on a periodic basis with technical assistance from the project safety supervisor, industrial hygienist or site safety representative.
- o Consults with the project safety supervisor, industrial hygienist or site safety representative to classify new entries or reclassify existing confined spaces.

13.3.2 Site Safety Supervisor/Industrial Hygienist/Site Safety Representative

The project safety supervisor/representative or industrial hygienist is responsible for the oversight of the technical aspects of this procedure. If there is no safety representative assigned, technical responsibility will be assumed by project management with support provided by the project's regional industrial hygiene resource or by the Manager of Environmental Services. The technical elements to which these individuals are to be held accountable include the following.

- o Classifies each confined space relative to the need for an entry permit.
- o Reviews and reclassifies confined spaces at the request of project management
- o Trains supervisors and competent persons relative to their responsibilities and duties in connection with the confined space entry program.
- o Reviews and approves the selection of all safety, personal protective equipment and instrumentation.
- o Audits confined space entry program execution.

13.3.3 Competent Person

The responsibilities assumed by the competent person are those related to the actual execution of the task. As such, this individual's principal duties include the following.

- o Prior to entry, evaluates each confined space for existing or potential hazards.
- o Monitors the atmosphere of the confined space. Assures that instruments are properly maintained and calibrated.
- o Notifies project management of any tasks to be performed within a confined space which could create a hazardous atmosphere.
- o Obtains an entry permit when one is required.
- o Reviews provisions of the entry permit with employees entering the confined space prior to entry.
- o Instructs employees and directs the execution of the confined space entry according to established procedures.
- o Assures that proper personal protective equipment is provided and used, as required.
- o Designates a trained attendant for each confined space.
- o Train all personnel involved in confined space entry and emergency rescue.
- o When the entry has been completed, verifies that all personnel and equipment have been removed from the confined space and signifies that the space may be prepared for return to service.

13.3.4 Employees

All MK-Ferguson, Eastman Kodak employees and authorized subcontractors are responsible for adherence to the provisions of the procedure. Additional responsibilities include:

- o Never entering any confined space without proper authorization.
- o Use of all safety and personal protective equipment in accordance with the training provided.

13.4 DEFINITIONS

13.4.1 Attendant

An attendant is the person assigned to remain immediately outside the entrance of the confined space during the time the space is occupied. This person is to maintain visual and/or voice contact with the personnel in the confined space at all times. The attendant must also have an immediate and direct means of communication by which rescue or other emergency assistance may be summoned. The attendant is not to enter the confined space unless appropriately trained and equipped and another trained attendant is present.

13.4.2 Confined Space

A confined space is considered any enclosure that is not designed for normal occupancy by humans; contains an actual or potential safety and/or health hazard, and restricts egress to such an extent that personnel would have difficulty in escaping in the event of an emergency. Examples of spaces fitting this description include the following.

- o Reactor vessels
- o Tanks and bins
- o Vats
- o Boilers
- o Vaults
- o Manholes
- o Sumps and open-top pits having a depth in excess of four feet.

Two classifications of confined spaces are recognized.

13.4.2.1 Non-Permit Entry

A confined space for which an entry permit is not required is one which has been thoroughly evaluated relative to prior usage. No mechanical, physical, electrical or chemical hazards are present or will be created as a result of the task being performed in the confined space. A non-permit entry space may be a confined space which has been equipped with mechanical systems such as continuous ventilation or a continuously monitoring oxygen alarm system.

13.4.2.2 Permit Entry

A confined space requiring an entry permit is one in which a mechanical, electrical, physical or chemical hazard is present or may be created as a result of the task being performed. Positive environmental control will be used whenever possible to mitigate oxygen deficient or otherwise hazardous environments.

No authorization is to be given for entry into confined spaces that are considered immediately dangerous to life and health (IDLH) or where the potential exists for the generation of such.

13.4.3 Entry

An entry is considered an action which results in the body breaking the plane of any confined space opening.

13.4.4 Entry Permit (Appendix A)

The confined space entry permit provides a checklist of pre-entry precautions which must be taken. Documentation of monitoring and authorization of entry will then be provided by project management. A copy of the permit must be posted at the job site. The permit must provide a record of the date of entry, monitoring requirements, location entry and a description of the work to be performed.

13.4.5 Hazardous Atmosphere

A hazardous atmosphere is one which poses a threat to the individual whether it is oxygen deficiency (less than 19.5% by volume), toxic (in excess of the permissible exposure limit of a given compound) or explosive (greater than 25% of the lower explosive limit as measured against a pentane standard).

13.4.6 Competent Person

The competent person refers to the individual who is providing immediate supervision of the personnel making the confined space entry.

13.4.7 Lower Explosive Limit

The lower explosive limit (lel) represents the minimum concentration of a combustible gas in air that will ignite and burn. 25% of the lel (as pentane) in a confined environment is the established action level for worker evacuation.

13.5 ENTRY REQUIREMENTS

13.5.1 Preparation Prior to Entry of a confined space requiring a permit.

- a. Determine any unusual conditions which may require special procedures unique to the area or the task to be conducted i.e., welding.
- b. Purge, drain and/or evacuate process materials and chemicals to the extent feasible.
- c. Isolate the confined space from all external piping, process systems, effluent systems, utilities, and ducts that could cause materials to enter the confined space. This may be accomplished by inserting blanks and skillets, disconnection and capping of lines, double blocking and bleeding valves (the nominal diameter of the bleed line must be at least equivalent to the nominal diameter of the line serviced) and/or physical disconnection of equipment.
- d. Immobilize all mechanical services such as agitators, mixer paddles, fan blades, etc., through established lockout procedures and/or through physical disconnection of the drive mechanism from the power source.
- e. Provide ventilation for the area by using forced air supply (breathing air quality) and/or air exhaust equipment. Ventilation is to continue as long as personnel are in the confined work space.
- f. Once the area has been opened and the ventilation initiated, the following parameters are to be evaluated:
 - oxygen level - at least 19.5% but less than 25%
 - lower explosive level (lel) - potentially explosive vapors and dust must be at or below 25% of their respective lel before personnel may enter the proposed work area, assuming the appropriate PPE is being worn.
 - toxic material concentrations - the atmosphere within the confined space must not contain concentrations of toxic materials which exceed established exposure levels. Every effort must be made to reduce airborne concentrations of hazardous materials to levels which are lower than established exposure limits. If that is not feasible, special precautionary measures will be required.
 - continuous monitoring - the need for continuous monitoring of these parameters will be determined on a case-by-case basis by project management with technical support provided by the project safety supervisor or industrial hygienist.
 - next shift monitoring - in the event that the work in the confined space is to continue past the initial shift, the atmosphere must be remonitored at the beginning of each subsequent work shift.
- g. The following safety equipment may be required to be used during vessel entry:
 - Body harnesses with attached connections for chain or rope hoist.
 - Self Contained Breathing Apparatus (SCBA), two units minimum.
 - 20# ABC fire extinguisher when flammable materials are involved.
 - Emergency escape breathing apparatus. Requirements for use will be determined on a case-by-case basis.

- Equipment (hoist, hand lines, etc) for removing an incapacitated individual during an emergency.
 - Access ladder.
 - Atmospheric monitoring instrumentation.
- h. When the use of special protective equipment (respirators, gloves, clothing, eye protection, etc) is required, their use must be specified in the entry permit and all associated training requirements must be met.

13.5.2 General Requirements and Procedures for a Permit Entry into a Confined Space

- a. No person shall enter a confined space until all the preparations for entry have been completed, the permit has been approved, all conditions of this Standard Operating Procedure have been met, and the entry is authorized.
- b. No person shall enter a confined space unless an attendant is at the entry. The attendant must maintain visual and/or voice contact at all times with personnel in the confined space.
- c. In the event of an emergency, the attendant shall summon assistance and shall not enter the confined space unless he/she has received emergency rescue training and another trained attendant is present.
- d. All personnel entering confined spaces and all attendants for such entries must receive confined space entry training and emergency rescue training annually.
- e. Personnel using monitoring equipment must be trained in its use and calibration.
- f. All electrical shock hazards shall be attenuated by use of low voltage systems and/or ground fault protection.
- g. Explosion-proof electrical equipment shall be required for entry into those spaces where the potential for fire and/or explosion exists.
- h. When all of the above conditions have been met, protective equipment specified for the job, the access ladder secured, lock-outs verified, and the permit completed both Project Management and the Competent Person shall sign the permit, which shall be posted in a conspicuous location at the job site.
- i. Whenever conditions in the confined space change, personnel must be removed, the changes investigated, lock-outs re-verified, and the area re-monitored.
- j. In the event that the work in the confined space is to continue past the initial shift, Project Management and the Competent Person on the next shift must sign the permit, re-verify the lock-outs, re-monitor the atmosphere and record the data on the permit, verify that all other requirements of this procedure have been met, and inherit all of the responsibilities associated with the entry. This process must be repeated at the beginning of each subsequent shift.

- k. When the job has been completed, the Competent Person must verify that all personnel and equipment have been removed from the confined space. The Competent Person signifies that the work is completed and that the confined space may be prepared for return to service by signing the permit in the appropriate place and returning it to Project Management. The completed permit is then restored by Project Management for the duration of the job.

13.5.3 General Requirements and Procedures for a Non-Permit Entry into a Confined Space

- a. Determine any unusual or changed conditions which would warrant review and re-classification of the confined space.
- b. No person shall enter a confined space unless an attendant is at the entry. The attendant must maintain visual and/or voice contact at all times with personnel in the confined space.
- c. In the event of an emergency, the attendant shall summon assistance and shall not enter the confined space unless he/she has received emergency rescue training and another trained attendant is present.
- d. All personnel entering confined spaces and all attendants for such entries must receive confined space entry training annually.
- e. Personnel using monitoring equipment must be trained in its use and calibration.
- f. Whenever conditions in the confined space change, personnel must be removed, the change is investigated, lock-outs re-verified and the area re-monitored.
- g. In the event that work in the confined space is to continue past the initial shift, project management and the competent person on the next shift must sign the permit, re-verify and record the data on the permit, verify that all other requirements of this procedure have been met and inherit all of the responsibilities associated with the entry.

ORIGINAL
(Red)

INSPECTIONS AND TESTS FOR ENTRY INTO CONFINED SPACES

Date _____
Job Number _____
Page _____ of _____

Division: _____ Division Location: _____
Customer: _____ Customer Address: _____
General Job Location: _____ Tank Or Vessel No. / Name: _____
Describe Material In Space: _____
Description Of Work Planned: _____ Chemicals Introduced Into Space: _____

TESTS										OTHERS		
TIME	PERCENT LOWER EXPLOSION LIMIT	PERCENT OXYGEN	BENZENE (ppm)	TOLUENE (ppm)	XYLENE (ppm)	H ₂ S (ppm)	CO (ppm)	(ppm)	(ppm)	(ppm)	ATMOSPHERE CLASS	INITIAL

CHECK LIST		Initial		PERSONNEL PROTECTIVE EQUIPMENT
		Yes	Does Not Apply	
All lines leading to and from confined space have been blinded or locked out _____				EYES <input type="checkbox"/> Chemical Goggles <input type="checkbox"/> Face Shield <input type="checkbox"/> Safety Glasses
Service disconnected or locked out _____				
Grounding and bonding cables in place _____				
Lighting, fittings, and extension cords are approved explosion proof equipment _____				EXTREMITIES <input type="checkbox"/> Hard Hat <input type="checkbox"/> Gloves <input type="checkbox"/> Boots : PVC : Insulate <input type="checkbox"/> Hoods : PVC : Insulate <input type="checkbox"/> Foot Coverings, Disposable : Latex : Other _____
Ground Fault Circuit Indicator (GFCI) checked and functioning _____				
All electrical sources have been isolated _____				
Breathing supply and alarms checked and are in proper condition _____				BODY <input type="checkbox"/> Encapsulating Suit : PVC : Air <input type="checkbox"/> Heavy Suit : PVC : Insulate <input type="checkbox"/> Intermediate Suit : PVC : Other <input type="checkbox"/> Light Suit : Other : Other : Other
The complete respiratory supply system has been checked and is in proper condition _____				
All safety harnesses and life lines checked and in proper condition _____				
Required protective clothing, gloves, boots, etc., being used _____				RESPIRATORY <input type="checkbox"/> Self-Contained Respirator <input type="checkbox"/> Air Line Respirator <input type="checkbox"/> Air Line W/Egress <input type="checkbox"/> Cartridge Respirator Cartridge Type _____
Employees have been trained in the use, care, and limitations of their respiratory protective equipment _____				
Outside safety watch trained in emergency procedures and resuscitation _____				
Vessel contains labeled product _____				OTHER <input type="checkbox"/> Hearing Protection <input type="checkbox"/> Parachute Harness and Lifeline (Top Entry) <input type="checkbox"/> Chest Harness and Lifeline (Side Entry)
All emergency systems such as air packs, fire extinguishers, backup breathing supply, alarms, etc., ready for use _____				
Special warning / caution signs posted _____				
Ventilation equipment in use _____				
No employee with facial hair, eye glasses, or other gas tight seal obstructions will do work which requires a respirator, or act as emergency standby _____				
Employees will not wear contact lenses in an atmosphere where a respirator is required _____				
Instructions: _____				

Qualified Person: _____
Name Printed _____ Signature _____ Date _____
Manager _____ Date _____

Diagram the Confined Space. Indicate the location of manways and ventilators. (Red)
Indicate the locations where tests were conducted.

ORIGINAL

View From Top
(Indicate North)

View From Side

—) (— MANWAYS

(∞) VENTILATOR

X-TEST LOCATION

THIS LOG OF INSPECTIONS AND TESTS FOR PERMIT TO ENTER A CONFINED SPACE IS APPLICABLE AND VALID ONLY FOR ONE SHIFT AND ONLY FOR THE EMPLOYEES DESIGNATED BELOW.

EMPLOYEES ASSIGNED (PRINT NAMES)

STANDBY PERSON(s) ASSIGNED
(PRINT NAMES)

QUALIFIED PERSON(s) (PRINT NAMES)

SUPERVISOR
PRINT NAME

SIGNATURE

DATE

ORIGINAL
(Red)

ORIGINAL
(Red)

EXHIBIT H

STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURES

1.0 MOBILIZATION & PROJECT INTEGRATION

Snake Bites

Normally, the noise of a person approaching a snake habitat is sufficient to frighten the snakes off. Extreme caution is necessary when exploring areas where snakes might be found such as behind rocks, under bushes, or in holes, crevices, and abandoned pipes.

The rules to follow if bitten by a snake are:

- o Do not lance bite area. Lancing will exacerbate the effect of the venom.
- o Do not apply suction to the wound. Suction is minimally effective in removing venom.
- o Do not apply ice. Snake venom is most active (destructive) at 70°F.
- o Do not apply a tourniquet. Venom is most dangerous when concentrated in a small area.
- o Do not allow victim to run for help. Running accelerates circulation.
- o Do seek immediate medical attention. The H&S Manager or a supervisor will summon emergency medical services.
- o Do keep victim calm and immobile.
- o Do have victim hold affected extremity lower than body while awaiting ambulance.

The buddy system is mandatory for personnel exploring areas that may contain snake habitats.

Poison Oak and Ivy

Poison oak and ivy may cause severe contact dermatitis in certain individuals and is present on this site, mainly in wooded areas. Unless all undergrowth is cleared from this area, all personnel who have need to work there will be instructed in the recognition of poison oak and ivy. Individuals who are known to be sensitive to this plant shall be restricted from this area until the poison plants have been destroyed. Particular caution shall be used when burning cleared material in this area. Personnel shall remain upwind of fires whenever possible.

Safe Work Practices

- o Contaminated protective equipment, such as respirators, hoses, and boots, shall not be removed from control zones until they have been cleaned or properly packaged and labeled.
- o Legible and understandable precautionary labels shall be affixed prominently to containers of contaminated scrap, waste, debris, and clothing. Where wastes are potentially explosive, they will be so marked and stored separately.
- o Removal of contaminated soil from protective clothing or equipment by blowing, shaking or any other means which might disperse contaminants into the air is prohibited.
- o No food, beverage, tobacco products, or cosmetics shall be allowed in control zones.
- o Procedures for transporting and disposing of contaminated materials shall comply with all applicable local, state, and federal regulations.
- o Containers shall be moved with the proper equipment only and shall be secured to prevent dropping or loss of control during transportation.
- o Emergency equipment shall be located outside control zones in readily accessible locations that are most likely to remain minimally contaminated in an emergency.
- o Liquid storage facilities shall be designed to contain spills completely within surrounding dikes.
- o All personnel shall avoid contact with potentially contaminated substances. Walking through water puddles or mud and kneeling on the ground should be avoided whenever possible.
- o Field personnel must observe each other for signs of toxic exposure. Indications of adverse effects include, but are not limited to:
 - Change in complexion or skin discoloration
 - Change in coordination
 - Change in demeanor
 - Excessive salivation
 - Excessive pupillary response
 - Change in speech pattern

- o Field personnel shall be cautioned to inform each other of inapparent effects of toxic exposure or heat stress such as:
 - Headache
 - Dizziness
 - Nausea
 - Blurred vision
 - Cramps
 - Irritations of eyes, skin, or respiratory tract
- o Prompt remedial action shall be taken whenever an inadvertent release of hazardous material occurs.
- o Appropriate action shall be taken to provide secure footing at all work locations.
- o Smoking is permitted only in designated areas.
- o All boreholes, excavations, and manways shall be filled when abandoned.

2.0 SITE PREPARATION

General Construction Safety Equipment

All construction activities shall be conducted in accordance with OSHA's construction standards as set forth in 29 CFR 1926.

- o Only trained and experienced equipment operators shall be employed.
- o Equipment shall be checked daily for defects prior to use. These checks shall include chains, wire cables, straps and hooks.
- o Audible backup signals shall be required on all loading and hauling equipment.
- o Roll-over protection systems shall be required on all construction equipment.
- o All equipment used in areas of potential explosives hazards will be equipped with a blast shield to protect operators.
- o Damaged equipment shall be removed or tagged as out of service.
- o Foot traffic shall be restricted in areas where heavy equipment is in use.

- o Operators shall wear hearing protection when equipment is in use. Personnel in the immediate vicinity shall also wear hearing protection.
- o There shall be no riding of the equipment unless a seat is provided for this purpose.
- o Where pedestrians are assisting equipment operators, hand signals shall be established beforehand. Only one person shall give these hand signals.
- o Hard hats, safety glasses, and boots with steel toes and shanks shall be worn by all personnel in operating areas.
- o Under no circumstances shall repair welding be permitted in a control zone. All hot work shall be conducted in approved areas only.
- o No personnel are permitted within the swing radius of an excavator without notifying the operator.
- o Excavators and coring rigs must be inspected by a competent person prior to each use. Deficiencies shall be repaired and defective parts replaced before use is continued.
- o Except where electrical transmission lines have been de-energized and visible grounded or other equipment has been installed to prevent physical contact with the lines, excavators and coring rigs shall conform to the following clearances:
 - Lines Rated at 50 kV or Less: Minimum clearance 10 feet
 - Lines Over 50 kV: Minimum clearance 10 feet, plus one foot for each additional 30 kV

Excavation Safety

All excavations are to be conducted in compliance with 29 CFR 1926 Subpart P, OSHA's standard for excavations. The following are key points:

- o Determine whether there are underground utilities in the area to be excavated. This may be done by consulting site drawings or inquiring at the local utilities.
- o Guard any excavation that is deeper than five feet against the hazard of moving ground or cave-in by shoring, sloping, or benching if personnel are to enter the excavation.

- o Place excavation spoils at least two feet from the edge of any excavation into which employees may be required to enter.
- o Inspect excavations daily for evidence of moving ground. If such is detected, all work in the excavation shall cease until appropriate precautions have been taken.
- o Provide adequate means of entry, such as ladders, into excavations that are deeper than four feet. Ladders shall be placed no more than 25 feet apart.
- o Use excavation equipment to test bank stability prior to approach by personnel.

Confined Spaces

Confined spaces with limited means of ingress or egress, limited ventilation, or a potential for the presence of toxic air contaminants are not likely to be encountered on this project, except possibly in tank demolitions. The following steps must be taken to assure personnel safety in such conditions.

- o All confined spaces must be tested for combustible gases, oxygen content, and toxic gases or vapors prior to personnel entry.
- o No entry is permitted if combustible gas readings exceed 10%, the oxygen level is less than 19.5%, or toxic gas or vapor levels are unacceptable.
- o The H&S Manager shall provide the necessary guidelines with respect to acceptable toxic gas or vapor levels.
- o Tests of confined spaces shall be good only for the time at which the test is made and under the conditions under which the test is made. Additional testing is essential as conditions change.
- o Testing results shall be documented on a confined space entry form (see attachment).

Hot Work In Hazardous Locations

- o Hot work is permitted only in areas that are documented as fire safe by the hot work permit (see attachment).
- o No hot work is permitted in any area where combustible gas indicator readings exceed 10%.

- o No hot work is permitted on or around containers which may have contained combustible liquids, unless the liquids have been purged or rendered inert.
- o Combustible liquids and materials shall be maintained at least 35 feet from hot work areas.
- o A fully charged fire extinguisher of minimum rating of 10 ABC shall be available wherever hot work is conducted.
- o Changes in work conditions may require that hot work permits be updated. At any rate, the maximum validity of these permits is eight hours.

INSPECTIONS AND TESTS FOR ENTRY INTO CONFINED SPACES

Date _____
Job Number _____
Page _____ of _____

Division: _____ Division Location: _____
Customer: _____ Customer Address: _____
General Job Location: _____ Tank Or Vessel No. / Name: _____
Describe Material In Space: _____
Description Of Work Planned: _____ Chemicals Introduced Into Space: _____

TESTS												OTHERS		ATMOSPHERE CLASS	INITIAL
TIME	PERCENT LOWER EXPLOSION LIMIT	PERCENT OXYGEN	BENZENE (ppm)	TOLUENE (ppm)	XYLENE (ppm)	H ₂ S (ppm)	CO (ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)		

CHECK LIST	Initial		PERSONNEL PROTECTIVE EQUIPMENT
	Yes	Does Not Apply	
All lines leading to and from confined space have been blinded or disconnected _____			EYES <input type="checkbox"/> Chemical Goggles <input type="checkbox"/> Face Shield <input type="checkbox"/> Safety Glasses EXTREMITIES <input type="checkbox"/> Hard Hat <input type="checkbox"/> Gloves <input type="checkbox"/> Boots : PVC : Neoprene <input type="checkbox"/> Hoods : PVC : Neoprene <input type="checkbox"/> Foot Coverings, Disposable : Latex : Other types BODY <input type="checkbox"/> Encapsulating Suit : PVC : Any <input type="checkbox"/> Heavy Suit : PVC : Neoprene <input type="checkbox"/> Intermediate Suit : PVC : Other <input type="checkbox"/> Light Suit : Other : Other : Other RESPIRATORY <input type="checkbox"/> Self-Contained Respirator <input type="checkbox"/> Air Line Respirator <input type="checkbox"/> Air Line W/Egress <input type="checkbox"/> Cartridge Respirator Cartridge Type _____ OTHER <input type="checkbox"/> Hearing Protection <input type="checkbox"/> Parachute Harness and Lifeline (Top Entry) <input type="checkbox"/> Chest Harness and Lifeline (Side Entry)
Electrical service disconnected or locked out _____			
All grounding and bonding cables in place _____			
All lighting, fittings, and extension cords are approved explosion proof equipment _____			
Ground Fault Circuit Indicator (GFCI) checked and functioning _____			
All ignition sources have been isolated _____			
Breathing supply and alarms checked and are in proper condition _____			
The complete respiratory supply system has been checked and is in proper condition _____			
All safety harnesses and life lines checked and in proper condition _____			
Required protective clothing, gloves, boots, etc., being used _____			
Employees have been trained in the use, care, and limitations of their respiratory protective equipment _____			
Outside safety watch trained in emergency procedures and resuscitation _____			
Vessel contains leaded product _____			
All emergency systems such as air packs, fire extinguishers, backup breathing supply, alarms, etc., ready for use _____			
Special warning / caution signs posted _____			
Ventilation equipment in use _____			
No employee with facial hair, eye glasses, or other gas tight seal obstructions will do work which requires a respirator, or act as emergency standby _____			
Employees will not wear contact lenses in an atmosphere where a respirator is required _____			

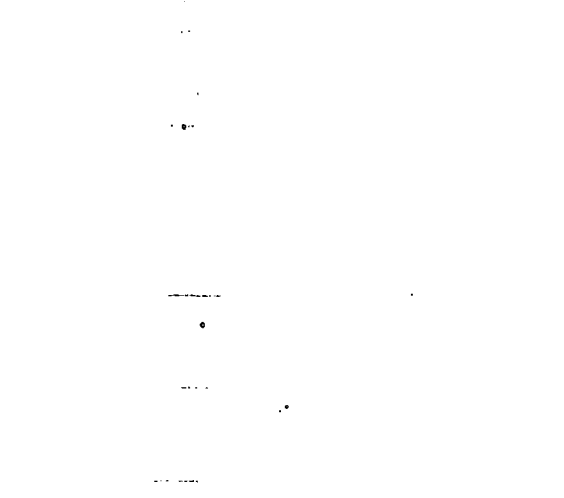

Per Instructions: _____

Qualified Person: _____
Name Printed _____ Signature _____ Date _____

CONTINUED ON REVERSE

Manager _____ Date _____

Diagram the Confined Space. Indicate the location of manways and ventilators. Indicate the locations where tests were conducted.

View From Top (Indicate North)	View From Side
	

[illegible]

THIS LOG OF INSPECTIONS AND TESTS FOR PERMIT TO ENTER A CONFINED SPACE IS APPLICABLE AND VALID ONLY FOR ONE SHIFT AND ONLY FOR THE EMPLOYEES DESIGNATED BELOW.

EMPLOYEES ASSIGNED (PRINT NAMES)

**STANDBY PERSON(S) ASSIGNED
(PRINT NAMES)**

QUALIFIED PERSON(s) (PRINT NAMES)

SUPERVISOR
PRINT NAME _____

SIGNATURE _____ **DATE** _____

SEE REVERSE

HOT WORK PERMIT

Operating Area _____ Good for this date only _____ 19 ____
Specific vessel or equipment _____
Work to be done _____

TESTS

STATE EXACT LOCATION OF TEST	TIME	PERCENT LOWER EXPLOSION LIMIT	PERCENT OXYGEN	OTHERS	INITIAL

CHECK LIST

INITIAL

YES DOES NOT
APPLY

PERSONNEL PROTECTIVE EQUIPMENT

EYES

Chemical Goggles
Face Shield
Safety Glasses
Welders Mask

BODY

Environmental Suit PVC
Heavy Suit PVC Neoprene
Light PVC Suit
Yellow Tyvek Suit
White Tyvek Suit

EXTREMITIES

Hard Hat
Gloves
Boots PVC Neoprene
Hoods PVC Neoprene
Foot Coverings

DISPOSABLE

RESPIRATORY

Self-Contained Respirator
Hose Line Respirator
Hose Line W/Egress
Cartridge Type _____

DUST RESPIRATOR

EQUIPMENT REQUIRED

Fire Extinguisher
Fire Blanket
Charged Water Hose
Combustible Gas Indicator

Operations plant personnel have been informed
of work to be performed
All tanks/lines/valves are disconnected blinded
or locked out
Equipment and all attached piping has been
cleaned and purged with (check blank) water _____
Steam _____ Inert Gas _____ Air _____
Electrical service has been locked out and
tagged
All grounding/bonding wire in place
Surrounding equipment and operations are safe
for hot work
No open vessels or lines within 35 feet of hot
work area
Combustible items within 35 feet of hot work
area have been removed or covered with wetted
tarpaulins
Fire Watch has been provided by Contractor
No flammable gases greater than 10% LEL in hot
work area
All requirements of MKE for Confined space Entry
have been met and MKE forms have been completed
and posted

Special Instructions: _____

Completed by _____
Name Printed Signature Date

MANAGER